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URANIUM AND GEOLOGY—II

RADIO-ACTIVE DEPOSITS AND THE INSTABILITY OF THE CRUST

AT the meeting of the British Association held last year at Leicester, I read a note on the thermal effects which might be expected to arise at the base of a sedimentary accumulation of great thickness due to the contained radium.

The history of mountain-building has repeated itself many times: ages of sedimentation, with attendant sinking of the crust in the area of deposition, then upheaval, folding up of the great beds of sediment, and even their over-thrusting for many miles. So that the mountain ranges of the world are not constituted from materials rising from below, save in so far as these may form a sustaining core, but of the slowly accumulating deposits of the ages preceding the upheaval.

The thickness of collected sediments involved in these great events is enormous, and although uncertainty often attends the estimation of the aggregate depths of sedimentation, yet when we consider that unconformities between the deposits of succeeding eras represent the removal of vast masses of sediment to fresh areas of deposition, and often in such a way as to lead to an under-estimate of the thickness of deposit, the observations of the geologist may well indicate the minor and not the major limit. Witness the mighty layers of the Huronian, Animikean and Keweenawan ages where deposits measured in miles of thickness are succeeded by unrecorded intervals of time, in which we know with

certainty that the tireless forces of denudation labored to undo their former work. Each era represents a slow and measured pulse in the earth's crust, as if the overloading and sinking of the surface materials induced the very conditions required for their reelevation. Such events, even in times when the crust was thinner and more readily disturbed than it is now, must have taken vast periods of time. The unconformity may represent as long a period as that of accumulation. In these Proterozoic areas of America, as elsewhere on the globe and throughout the whole of geological history, there has been a succession in time of foldings of the crust always so located as to uplift the areas of sedimentation, these upheavals being sundered by long intervals during which the site of sedimentation was transferred and preparation made for another era of disturbance. However long deferred, there seems to be only the one and inevitable ending, inducing a rhythmic and monotonous repetition surely indicative of some cause of instability attending the events of deposition.

The facts have been impressively stated by Dana:

> A mountain range of the common type, like that to which the Appalachians belong, is made out of the sedimentary formations of a long preceding era; beds that were laid down conformably, and in succession, until they had reached the needed thickness; beds spreading over a region tens of thousands of square miles in area. The region over which sedimentary formations were in progress in order to make, finally, the Appalachian range, reached from New York to Alabama, and had a breadth of 100 to 200 miles, and the pile of horizontal beds along the middle was 40,000 feet in depth. The pile for the Wahsatch Mountains was 60,000 feet thick, according to King. The beds for the Appalachians were not laid down in a deep ocean, but in shallow waters, where a gradual subsidence was in progress; and they at last, when ready for the genesis, lay in a trough 40,000 feet deep, filling the trough to the brim. It thus appears that epochs of mountain-making have occurred only after long intervals of quiet in the history of a continent.

The generally observed fact that the deposition of sediments in some manner involves their ultimate upheaval has at various times led to explanations being offered. I think I am safe in saying that although the primary factor, the compressive stress in a crust which has ceased to fit the shrinking world within it, has probably been correctly inferred, no satisfactory explanation of the connection between sedimentation and upheaval has been advanced. The mere shifting upwards of the isogeotherms into the deposits, advanced as a source of local loss of rigidity by Babbage and Herschel, need not involve any such loss so long as the original distance of the isogeotherms from the surface is preserved.

We see in every case that only after great thickness of sediments has accumulated is the upheaval brought about. This is a feature which must enter as an essential condition into whatever explanation we propose to offer.

Following up the idea that the sought-for instability is referable to radio-thermal actions, we will now endeavor to form some approximate estimate of the rise of temperature which will be brought about at the base of such great sedimentary accumulations as have gone towards mountain-building, due to the radium distributed throughout the materials.

The temperature at the base of a feebly radio-active layer, such as an accumulation of sediments, is defined in part by radio-active energy, in part by its position relative to the normal isogeotherms, whether these latter are in turn due to or influenced by radio-thermal supplies or not. It is convenient, and I think allowable, to consider these two effects separately, and deal with them as if they were independent,

the resultant state being obtained by their summation.

In dealing with the rise of temperature at the base of a radio-active layer we arrive at an expression which involves the square of the depth. This is a very important feature in the investigation, and leads to the result that, for a given amount of radium, diffuse distribution through a great depth of deposit gives rise to a higher basal temperature than a more concentrated distribution in a shallower layer.

But this will not give us the whole effect of such a deposit. Another and an important factor has to be taken into account. We have seen that the immediate surface rocks are of such richness in radium as to preclude the idea that a similar richness can extend many miles inward.

Now, it is upon this surface layer that the sediments are piled, and as they grow in thickness this original layer is depressed deeper and deeper, yielding under the load until at length it is buried to the full depth of the overlying deposit. This slow and measured process is attended by remarkable thermal effects. The law of the increase of temperature with the square of the depth comes in, and we have to consider the temperature effect not merely at the base of the deposited layer, but that due to the depression and covering over of the radium-rich materials upon which the sediments were laid down.

The table which follows embodies an approximate statement of the thermal results of various depths of deposit supposed to collect under conditions of crustal temperature such as prevail in this present epoch of geological history.

I have deferred to the conclusion of this address an account of the steps followed in obtaining the above results. It is clearly impossible, within the limited time allotted to me, to make these quite clear. It must suffice here merely to explain the significance of the figures.

Thickness of Sedimentary Deposit Kilometers	Resulting Rise of Isogeotherms Kilometers	Weakening of Earth's Crust as Defined by the Rise of the Geotherm at 40 Kilometers Kilometers
6	7.4	40 to 32.6
8	10.2	40 to 29.8
10	13.3	40 to 26.7
12	16.7	40 to 23.3
14	20.4	40 to 19.6

The first column gives the depth of sedimentary deposit supposed to be laid down on the normal radio-active upper crust of a certain assumed thickness and radio-activity. From the rise of temperature which occurs at the base of this crust (due to the radio-activity, not only of the crust, but of the sediments) the results of the second column are deduced, the gradient or slope of temperature prevailing beneath being derived from the existing surface gradients corrected for the effects of the radio-thermal layer. The third column is intended to exhibit the effect of this shift of the geotherms in reducing the strength of the crust. I assume that at a temperature of 800° the deep-seated materials lose rigidity under long-continued stress. The estimated depth of this geotherm is, on the assumptions, about 40 kilometers. The upward shift of this geotherm shows the loss of strength. Thus in the case of a sedimentary accumulation of 10 kilometers the geotherm defining the base of the rigid crust shifts upwards by 13 kilometers, so that there is a loss of effective section to the amount of 30 per cent.

As regards the claims which such figures have upon our consideration, my assumptions as to thickness and radio-activity of the specially rich surface layer are, doubtless, capable of considerable amendment. It will be found, however, that the assumed factors may be supposed to vary consider-

ably, and yet the final results prove such as, I believe, can not be ignored. Indeed, those who are in the way of making such calculations, and who enter into the question, will find that my assumptions are not specially favorable, but are, in fact, made on quite independent grounds. Again, a certain class of effects has been entirely left out of account, effects which will go towards enhancing, and in some cases greatly enhancing, the radio-thermal activity. I refer to the thickening of the crust arising from tangential pressure, and, at a later stage, the piling up and overthrusting of mountain-building materials. In such cases the temperature of the deeper parts of the thickened mass must still further rise under the influence of the contained radium. These effects only take place, indeed, after yielding has commenced, but they add to the element of instability which the presence of the accumulated radio-active deposits occasions, and doubtless increase thermal metamorphic actions in the deeper sediments, and result in the refusion of rocks in the upper part of the crust.[19]

The effect of accumulated sediment is thus necessarily a reduction in the thickness of that part of the upper crust which is capable of resisting a compressive stress. Over the area of sedimentation, and more especially along the deepest line of synclinal depression, the crust of the globe for a period assumes the properties belonging to an earlier age, yielding up some of the rigidity which was the slow inheritance of secular cooling. Along this area of weakness—from its mode of formation generally much elongated in form—the stressed crust for many hundreds, perhaps thousands, of miles finds relief, and flexure takes place in the only possible direction; that is, on the whole upwards. In this way the prolonged anticline bearing upwards on its crest the whole mass of deposits is formed, and so are born the mountain ranges in all their diversity of form and structure.

We have in these effects an intervention of radium in the dynamics of the earth's crust, which must have influenced the entire history of our globe, and which, I believe, affords a key to the instability of the crust. For after the events of mountain-building are accomplished, stability is not attained, but in presence of the forces of denudation the whole sequence of events has to commence over again. Every fresh accession of snow to the firn, every passing cloud contributing its small addition to the torrent, assists to spread out once more on the floor of the ocean the heat-producing substance. With this rhythmic succession of events appear bound up those positive or negative movements of the strand which cover and uncover the continents, and have swayed the entire course of evolution of terrestrial life.

Oceanic Deposits.—The displacements of the crust which we have been considering are now known to be by no means confined to the oceanic margins. The evidence seems conclusive that long-continued movements have been in progress over certain areas of the sea floor, attended with the formation of those numerous volcanic cones upon which the coral island finds foundation. Here there are plainly revealed signs of instability and yielding of the crust (although, perhaps, of minor intensity) such as are associated with the greater movements which terminate in mountain-building. I think it will be found, when the facts are considered, that we have here

[19] Professor C. Schmidt (Basel) has recently given reasons for the view that the Mesozoic schists of the Simplon at the period of their folding were probably from 15,000 to 20,000 meters beneath the surface (*Ec. Geol. Helvetiæ*, Vol. IX., No. 4, p. 590). As another instance consider the compression of the Laramide range (Dawson, *Bull. Geol. Soc. Am.*, XII., p. 87).

phenomena continuous with those already dealt with, and although the conditional element of a sufficient sedimentary accumulation must remain speculative, the evidence we possess is in favor of its existence.

One of the most interesting outstanding problems of deep-sea physiography is that of the rates of accumulation of the several sorts of deposit. In the case of the more rapidly collecting sediments there seems no serious reason why the matter should not be dealt with observationally. I hope it may be accomplished in our time. For my present purpose I should like to know what may or may not be assumed in discussing the accumulation of radio-active sediments on the ocean floor.

As regards the rate of collection of the non-calcareous deposits, the nearest approach to an estimate is, I think, to be obtained from the exposed oceanic deposits of Barbados. In the well-known paper of Jukes Brown and Harrison[20] on the geology of that island, it is shown that the siliceous radiolarian earths and red clays aggregate to a thickness of about 300 feet. These materials are true oceanic deposits, devoid of terrigenous substances. They collected very probably during Pliocene and, perhaps, part of Pleistocene times. Now, there is evidence to lead us to date the beginning of the Pliocene as anything from one million to three million years ago. The mean of these estimates gives a rate of collection of 5 millimeters in a century. This sounds a very slow rate of growth, but it is too fast to be assumed for such deposits generally. More recent observations might, indeed, lead us to lengthen the period assigned to the deposition of these oceanic beds; for if, following Professor Spencer,[21] we ascribe their deposition to Eocene times, a less definite time-interval is indicated; but the rate could hardly have been less than 3 millimeters in a century. The site of the deposit was probably favorable to rapid growth.

We have already found a maximum limit to the average thickness of true oceanic sediments; and such as would obtain over the ocean floor if the rate of collection was everywhere the same and had so continued during the past. If there is one thing certain, however, it is that the rates of accumulation vary enormously. The 1,200 or 1,500 feet of chalk in the British Cretaceous, collected in one relatively brief period of submergence, would alone establish this. Huxley inferred that the chalk collected at the rate of one inch in a year. Sollas showed that the rate was more probably one inch in forty years. Sir John Murray has advanced evidence that in parts of the Atlantic the cables become covered with *Globigerina* ooze at the rate of about ten inches in a century. Finally, then, we must take it that the fair allowance of one seventh of a mile may be withheld in some areas and many times exceeded in others.

Now it is remarkable that all the conditions for rapid deposition seem to prevail over those volcanic areas of the Pacific from which ascend to the surface the coral islands—abundant pelagic life and comparatively shallow depths. Indeed, I may remind you that the very favorable nature of the conditions enter into the well-known theory of coral island formation put forward by Murray.

The islands arise from depths of between 1,000 and 2,000 fathoms. These areas are covered with *Globigerina* ooze having a radio-activity of about 7 or 8. The deeper-lying deposits around—red clay and radiolarian ooze—show radio-activities up to and over 50. From these no volcanic islands spring.

These facts, however, so far from being

[20] *Q. J. G. S.*, XLVIII., p. 210.
[21] *Ibid.*, LVIII., pp. 354 ff.

opposed to the view that the radio-activity and crustal disturbance are connected, are in its favor. For while those rich areas testify to the supply of radio-active materials, the slow rate of growth prevailing deprives those deposits of that characteristic *depth* which, if I may put it so, is of more consequence than a high radio-activity. For the rise in temperature at the base of a deposit, as already pointed out, is proportional to the square of the thickness; in reality the dilution of the supplies of uranium which reach the calcareous oozes flooring the disturbed areas is a necessary condition for any effective radiothermal actions.

It might appear futile to consider the matter any closer where so little is known. But in order to give an idea of the quantities involved I may state that, if my calculations are correct, a rate of deposit comparable with that of the chalk prevailing for ten million years would, on assumptions similar to those already explained when discussing the subject of mountain-building, occasion a rise of the deeper isogeotherms by from 20 to 30 per cent. of their probable normal depth.

In making these deductions as to the influence of radium in sedimentary deposits, I have so far left out of consideration the question of the time which must elapse in order that the final temperature-rise in the sediments must be attained. The question we have to answer is: Will the rate of rise of temperature due to radium keep pace with the rate of deposition, or must a certain period elapse after the sedimentation is completed to any particular depth, before the basal temperature proper to the depth is attained?

The answer appears to be, on an approximate method of solution, that for rates of deposition such as we believe to prevail in terrigenous deposits—even so great as one foot in a century, and up to depths of accumulation of 10 kilometers and even more—the heating waits on the sedimentation. Or, in other words, there is thermal equilibrium at every stage of growth of the deposit; and the basal temperature due to radioactive heating may at any instant be computed by the conductivity equation. For accumulations of still greater magnitude the final and maximum temperature appears to lag somewhat behind the rate of deposition.

From this we may infer that the great events of geological history have primarily waited upon the rates of denudation and sedimentation. The sites of the terrigenous deposits and the marginal oceanic precipitates have many times been convulsed during geological time because the rates of accumulation thereon have been rapid. The comparative tranquility of the ocean floor far removed from the land may be referred to the absence of the inciting cause of disturbance. If, however, favorable conditions prevail for such a period that the local accumulations attain the sufficient depth, here, too, the stability must break down and the permanency be interrupted.

Upheaval of the ocean floor, owing to the laws of deep-sea sedimentation, should be attended with effects accelerative of deposition—a fact which may not be without influence. But although ultimately sharing the instability of the continental margins, the cycle of change is tuned to a slower periodicity. From the operation of these causes, possibly, have come and gone those continents which many believe to have once replaced the wastes of the oceans, and which with all their wealth of life and scenic beauty have disappeared so completely that they scarce have left a wreck behind. But those forgotten worlds may be again restored. The rolled-up crust of the earth is still rich in energy borrowed from earlier

times, and the slow but mighty influences of denudation and deposition are forever at work. And so, perchance, in some remote age the vanished Gondwána Land, the lost Atlantis, may once again arise, the seeds of resurrection even now being sown upon their graves from the endless harvests of pelagic life.

JOHN JOLY

REPORT OF THE INTERNATIONAL CONFERENCE ON ELECTRICAL UNITS AND STANDARDS, 1908

THE report shows that delegates were present from 21 countries, and also from the following British dependencies, namely, Australia, Canada, India and the Crown Colonies.

The total number of delegates to the conference was 43, and their names are set out in schedule A. The conference and its technical committee each held five sittings. As a result of its deliberations, the conference adopted the resolutions and specifications set out in schedule B, and requested the delegates to lay them before their respective governments with a view to obtaining uniformity in the legislation with regard to electrical units and standards.

The conference recommends the use of the Weston normal cell as a convenient method of measuring both electromotive force and current when set up under the conditions specified in schedule C.

In cases in which it is not desired to set up the standards provided in the resolutions of schedule B, the conference recommends the following as working methods for the realization of the international ohm, the ampere and the volt:

1. *For the International Ohm.*—The use of copies, constructed of suitable material and of suitable form and verified from time to time, of the international ohm, its multiples and sub-multiples.

2. *For the International Ampere.*—(*a*) The measurement of current by the aid of a current balance standardized by comparison with a silver voltameter; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and international ampere, and of a resistance of known value in international ohms.

3. *For the International Volt.*—(*a*) A comparison with the difference of electrical potential between the ends of a coil of resistance of known value in international ohms, when carrying a current of known value in international amperes; or

(*b*) The use of a Weston normal cell whose electromotive force has been determined in terms of the international ohm and the international ampere.

The duty of specifying more particularly the conditions under which these methods are to be applied has been assigned to the permanent commission, and, pending its appointment, to the scientific committee, to be nominated by the president (see schedule D), who will issue a series of notes as appendix to this report.

The conference has considered the methods that should be recommended to the governments for securing uniform administration in relation to electrical units and standards, and expresses the opinion that the best method of securing uniformity for the future would be by the establishment of an international electrical laboratory with the duties of keeping and maintaining international electrical standards. This laboratory to be equipped entirely independently of any national laboratory.

The conference further recommends that action be taken in accordance with the scheme set out in schedule D.

SCHEDULE A.—LIST OF COUNTRIES AND DELEGATES

America (United States).—Dr. S. W. Stratton; Dr. Henry S. Carhart; Dr. E. B. Rosa.

Austria.—Dr. Viktor Edler von Lang; Dr. Ludwig Kusminsky.

Belgium.—Professor Eric Gérard; M. Clement.

Brazil.—Mr. L. Weiss.

Chile.—Don Victor Eastman.

Colombia.—Don Jorge Roa.

Denmark and Sweden.—Professor S. A. Arrhenius.

Ecuador.—Sr. Don Celso Nevares.

France.—Professor Lippmann; M. R. Benoît; M. de Nerville.

Germany.—Professor Warburg; Professor Jaeger; Professor Lindeck.

Great Britain.—The Right Hon. Lord Rayleigh (President); Professor J. J. Thomson; Sir John Gavey; Dr. R. T. Glazebrook; Major W. A. J. O'Meara; Mr. A. P. Trotter.

Guatemala.—Dr. Francisco de Arce.

Hungary.—Joseph Váter; Dr. Desiré Harsanyi.

Italy.—Professor Antonio Ròiti.

Japan.—Dr. Osuke Asano; Mr. Shigeru Kondo.

Mexico.—Don Alfonso Castelló; Don José Maria Perez.

Netherlands.—Dr. H. Haga.

Paraguay.—M. Maximo Croskey.

Russia.—Dr. N. Engoroff, Col. L. Swentorzetzky.

Spain.—Don José Maria Madariaga; Don A. Montenegro.

Switzerland.—Dr. Fr. Weber; Dr. Pierre Chappuis; Dr. J. Landry.

BRITISH COLONIES

Australia.—Mr. Cecil W. Darley; Professor Threlfall.

Canada.—Mr. Ormond Higman.

Crown Colonies.—Major P. Cardew.

India.—Mr. M. G. Simpson.

Secretaries.—Mr. M. J. Collins; Mr. W. Duddell; Mr. C. W. S. Crawley; Mr. F. E. Smith.

SCHEDULE B.—RESOLUTIONS

I. The conference agrees that as heretofore the magnitudes of the fundamental electric units shall be determined on the electromagnetic system of measurement with reference to the centimeter as the unit of length, the gram as the unit of mass and the second as the unit of time.

These fundamental units are (1) the ohm, the unit of electric resistance which has the value of 1,000,000,000 in terms of the centimeter and second; (2) the ampere, the unit of electric current which has the value of one tenth (0.1) in terms of the centimeter, gram and second; (3) the volt, the unit of electromotive force which has the value 100,000,000 in terms of the centimeter, the gram and the second; (4) the watt, the unit of power which has the value of 10,000,000 in terms of the centimeter, the gram and the second.

II. As a system of units representing the above and sufficiently near to them to be adopted for the purpose of electrical measurements and as a basis for legislation, the conference recommends the adoption of the international ohm, the international ampere and the international volt defined according to the following definitions.

III. The ohm is the first primary unit.

IV. The international ohm is defined as the resistance of a specified column of mercury.

V. The international ohm is the resistance offered to an unvarying electric current by a column of mercury at the temperature of melting ice, 14.4521 grams in mass, of a constant cross-sectional area and of a length of 106.300 centimeters.

To determine the resistance of a column of mercury in terms of the international ohm, the procedure to be followed shall be that set out in specification I. attached to these resolutions.

VI. The ampere is the second primary unit.

VII. The international ampere is the unvarying electric current which, when passed through a solution of nitrate of silver in water, in accordance with the specification II. attached to these resolutions, deposits silver at the rate of 0.00111800 of a gram per second.

VIII. The international volt is the electrical pressure which, when steadily applied to a conductor whose resistance is one international ohm, will produce a current of one international ampere.

IX. The international watt is the energy expended per second by an unvarying electric current of one international ampere under an electric pressure of one international volt.

SPECIFICATION I.—SPECIFICATION RELATING TO MERCURY STANDARDS OF RESISTANCE

The glass tubes used for mercury standards of resistance must be made of a glass such that the dimensions may remain as constant as possible. The tubes must be well annealed and straight. The bore must be as nearly as possible uniform and circular, and the area of cross-section of the bore must be approximately one square millimeter. The mercury must have a resistance of approximately one ohm.

Each of the tubes must be accurately calibrated. The correction to be applied to allow for the area of the cross-section of the bore, not being exactly the same at all parts of the tube, must not exceed 5 parts in 10,000.

The mercury filling the tube must be considered as bounded by plane surfaces placed in contact with the ends of the tube.

The length of the axis of the tube, the mass of mercury the tube contains, and the electrical resistance of the mercury are to be determined at a temperature as near to 0° C. as possible. The measurements are to be corrected to 0° C.

For the purpose of the electrical measurements, end vessels carrying connections for the current and potential terminals are to be fitted on to the tube. These end vessels are to be spherical in shape (of a diameter of approximately 4 centimeters), and should have cylindrical pieces attached to make connections with the tubes. The outside edge of each end of the tube is to be coincident with the inner surface of the corresponding spherical end vessel. The leads which make contact with the mercury are to be of thin platinum wire fused into glass. The point of entry of the current lead and the end of the tube are to be at opposite ends of a diameter of the bulb; the potential lead is to be midway between these two points. All the leads must be so thin that no error in the resistance is introduced through conduction of heat to the mercury. The filling of the tube with mercury for the purpose of the resistance measurements must be carried out under the same conditions as the filling for the determination of the mass.

The resistance which has to be added to the resistance of the tube to allow for the effect of the end vessels is to be calculated by the formula:

$$A = \frac{0.80}{1{,}063\pi}\left(\frac{1}{r_1}+\frac{1}{r_2}\right) \text{ ohm},$$

where r_1 and r_2 are the radii in millimeters of the end sections of the bore of the tube.

The mean of the calculated resistances of at least five tubes shall be taken to determine the value of the unit of resistance.

For the purpose of the comparison of resistances with a mercury tube the measurements shall be made with at least three separate fillings of the tube.

SPECIFICATION II.—SPECIFICATION RELATING TO THE DEPOSITION OF SILVER

The electrolyte shall consist of a solution of from 15 to 20 parts by weight of silver nitrate in 100 parts of distilled water. The solution must only be used once, and only for so long that not more than 30 per cent. of the silver in the solution is deposited.

The anode shall be of silver, and the cathode of platinum. The current density at the anode shall not exceed 1/5 ampere per square centimeter and at the cathode 1/50 ampere per square centimeter.

Not less than 100 cubic centimeters of electrolyte shall be used in a voltameter.

Care must be taken that no particles which may become mechanically detached from the anode shall reach the cathode.

Before weighing, any traces of solution adhering to the cathode must be removed, and the cathode dried.

SCHEDULE C.—WESTON NORMAL CELL

The Weston normal cell may be conveniently employed as a standard of electric pressure for the measurement both of e.m.f. and of current, and when set up in accordance with the following specification, may be taken, provisionally,[1] as having, at a temperature of 20° C., an e.m.f. of 1.0184 volts.

SPECIFICATION RELATING TO THE WESTON NORMAL CELL

The Weston normal cell is a voltaic cell which has a saturated aqueous solution of cadmium sulphate ($CdSO_4$ 8/3 H_2O) as its electrolyte.

The electrolyte must be neutral to Congo red.

The positive electrode is mercury.

The negative electrode of the cell is cadmium amalgam consisting of 12.5 parts by

[1] See duties of the scientific committee, schedule D.

weight of cadmium in 100 parts of amalgam.

The depolarizer, which is placed in contact with the positive electrode, is a paste made by mixing mercurous sulphate with powdered crystals of cadmium sulphate and a saturated aqueous solution of cadmium sulphate.

The different methods of preparing the mercurous sulphate paste are described in the notes.[2] One of the methods there specified must be carried out.

For setting up the cell, the H form is the most suitable. The leads passing through the glass to the electrodes must be of platinum wire, which must not be allowed to come into contact with the electrolyte. The amalgam is placed in one limb, the mercury in the other.

The depolarizer is placed above the mercury and a layer of cadmium sulphate crystals is introduced into each limb. The entire cell is filled with a saturated solution of cadmium sulphate and then hermetically sealed.

The following formula is recommended for the e.m.f. of the cell in terms of the temperature between the limits 0° C. and 40° C.

$$E_t = E_{20} - 0.0000406\ (t - 20°) - 0.00000095\ (t - 20°)^2 + 0.00000001\ (t - 20)^3.$$

SCHEDULE D

1. The conference recommends that the various governments interested establish a permanent international commission for electrical standards.

2. Pending the appointment of the permanent international commission, the conference recommends[3] that the president, Lord Rayleigh, nominate for appointment by the conference a scientific committee of 15 to advise as to the organization of the permanent commission, to formulate a plan for and to direct such work as may be necessary in connection with the maintenance of standards, fixing of values,[4] intercomparison of standards and to complete the work of the conference.[5] Vacancies on the committee to be filled by cooptation.

3. That laboratories equipped with facilities for precise electrical measurements and investigations should be asked to cooperate with this committee and to carry out, if possible, such work as it may desire.

4. The committee should take the proper steps forthwith for establishing the permanent commission, and are empowered to arrange for the meeting of the next conference on electrical units and standards, and the time and place of such meeting should this action appear to them to be desirable.

5. The committee or the permanent international commission shall consider the question of enlarging the functions of the international conference on weights and measures, with a view to determining if it is possible or desirable to combine future conferences on electrical units and standards with the international conference on weights and measures, in place of holding in the future conferences on electrical units and standards. At the same time it is the opinion of the conference that the permanent commission should be retained as a distinct body, which should meet at different places in succession.

[2] Notes on methods pursued at various standardizing laboratories will be issued by the scientific committee or the permanent commission, as an appendix to this report.

[3] In accordance with the above, Lord Rayleigh has nominated the following committee, which has been approved by the conference, viz: Dr. Osuke Asano, M. R. Benoît, Dr. M. N. Egoroff, Professor Eric Gérard, Dr. R. T. Glazebrook, Dr. H. Haga, Dr. L. Kusminsky, Professor G. Lippmann, Professor A. Ròiti, Dr. E. B. Rosa, Dr. S. W. Stratton, Mr. A. P. Trotter, Professor E. Warburg, Professor Fr. Weber.

[4] This will include the reconsideration, from time to time, of the E.M.F. of the Weston normal cell.

[5] With this object the committee are authorized to issue as an appendix to the report of the conference notes detailing the methods which have been adopted in the standardizing laboratories of the various countries to realize the international ohm and the international ampere, and to set up the Weston normal cell.

OTIS TUFTON MASON

On November 5, 1908, death claimed Professor Otis T. Mason, for the past six years head curator of the Department of Anthro-

pology in the United States National Museum, one of the founders and past president of the Washington Anthropological Society, and an eminent worker in ethnology of world-wide reputation.

Professor Mason was born in Eastport, Maine, April 10, 1838, and was a descendant of several of the oldest American families. He graduated in 1861, master of arts, from the Columbian University, in Washington, D. C., and was later made doctor of philosophy and doctor of laws by the same institution. From 1862 to 1884, he was principal of the Columbian Preparatory School.

His anthropological researches began at the Smithsonian Institution, in 1872. In 1874, he was made a collaborator in ethnology, and began to arrange the hitherto unclassified anthropological collections. From these beginnings have grown the present ethnological and archeological exhibits of the National Museum, and its department of anthropology.

In 1884, Professor Mason gave up the directorship of the Columbian Preparatory School and thenceforth devoted all his time to the United States National Museum, as curator of ethnology, and, finally, as the head of the much-enlarged and reorganized department.

Professor Mason was an invaluable officer of the Smithsonian Institution; a gentleman of the old school—delighting all who came in contact with him by his cheer, bravery under many personal adversities, ready wit, and optimism; a rare friend, help, and a constant inspiration to his associates; and a highly prolific and able worker in his chosen branch of research. He contributed to the literature of archeology and especially ethnology, uninterruptedly (excepting during his periods of illness) from 1874 until the end—his last completed paper appearing from the printer's hands on the day of his burial. He further contributed to the progress of anthropology by his museum exhibits, by special exhibits during expositions, and by courses of lectures in the Columbian University as well as outside of Washington. He organized and promoted the Saturday lectures in the National Museum. He was for years an associate editor of the *American Naturalist*, and assisted in Harper's "Annual Record of Science and Industry." In 1879, in company with J. M. Toner and Garrick Mallery, he participated in the first steps which resulted in the foundation of the Washington Anthropological Society. In 1889, his studies were declared by the French minister of instruction to be of public utility. In 1890, he was appointed a member of the national board of geographic names; and in the course of time he became a member of the leading anthropological societies in our own country and abroad.

The scientific work of Professor Mason was directed mainly to the American natives and covered a vast field of human activities. He was not able to personally carry on field work, but he described with rare precision and care the collections gathered in the Smithsonian Institution, and he brought together and collated much dispersed knowledge. And he had the rare gift of presenting the scientific data in such a style and manner that his works can be read with profit and pleasure by men and women of intelligence in all vocations. In some of the fields which he cultivated, such as that of American basketry, he covered the subject until but little can be added.

Most of Professor Mason's writings were published in the media of the Smithsonian Institution. A few of his principal contributions to science are: "The Latimer Collection of Antiquities from Porto Rico" (1876); "Throwing-Sticks in the National Museum" (1884); "Cradles of the American Aborigines" (1887); "Aboriginal Skin-Dressing" (1889); "North American Bows, Arrows, and Quivers" (1893); "Primitive Travel and Transportation" (1894); "Migration and the Food Quest" (1894); "Aboriginal American Harpoons" (1900); "Aboriginal American Basketry" (1884 and 1902); and many contributions in the "Handbook of American Indians" (1907, B. A. E.).

During the last four years, Professor Mason's aim, only partly accomplished, was to describe, in a thorough manner, the basketry, traps, etc., of Malaysia, represented in the National Museum by the rich W. L. Abbott collections.

Professor Mason's illness dated from 1898, when he was stricken with hemiplegia. From this, he was slowly but steadily recovering until the summer of this year, when his health commenced again to fail. As late as the 17th of October, he was still attending to his duties in the National Museum, but from that day on he rapidly failed, until the fatal termination.

His name, cherished by all those who knew him personally, will range in the history of anthropology side by side with those of Powell, Brinton and Gallatin. Aleš Hrdlička

THE CONVOCATION WEEK MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE AND AFFILIATED SOCIETIES

The preliminary announcement of the sixtieth meeting of the American Association to be held in Baltimore from December 28, 1908, to January 2, 1909, has now been issued by the permanent secretary. The first general session of the association will be held at 10 o'clock on the morning of December 28, in McCoy Hall, the Johns Hopkins University. The meeting will be called to order by the retiring president, Professor E. L. Nichols, who will introduce the president of the meeting, Professor T. C. Chamberlin. Addresses of welcome will be delivered by Dr. Ira Remsen, president of the Johns Hopkins University, and by Dr. Wm. H. Welch, chairman of the local committee for the meeting, and President Chamberlin will reply.

Most of the sections of the association and of the affiliated societies will meet at the Johns Hopkins University or the Baltimore City College or Baltimore Medical College adjoining, or else at the Johns Hopkins Medical School. The School Board of Baltimore City, the Baltimore Woman's College, the Bryn Mawr Preparatory School and the Maryland Academy of Sciences have placed other rooms at the disposal of the committee.

At 8 o'clock P.M., on Monday, the retiring president will give his address in McCoy Hall. At the close of the address a reception will be tendered by President Remsen and the board of trustees of the Johns Hopkins University.

On the afternoons of Tuesday, Wednesday and Thursday the addresses of the vice-presidents will be given. They are as follows: E. O. Lovett, Princeton; D. C. Miller, Cleveland; H. P. Talbot, Boston; O. H. Landreth, Schenectady; J. P. Iddings, Chicago; E. B. Wilson, New York; C. E. Bessey, Lincoln; Franz Boas, New York; J. F. Crowell, New York; Ludvig Hektoen, Chicago; Elmer Ellsworth Brown, Washington.

On these and the following days the sections and societies will hold their regular sessions. It is expected that there will be joint meetings when the same subjects are covered, and that some meetings will be arranged for of general interest to all members of the association. No definite arrangements are announced for the general evening functions after Monday night. Dinners and meetings of special societies and groups, smokers and informal meetings, may be arranged.

On Thursday, December 31, a meeting of the American Health League will be called in conjunction with Section I, and a symposium on "Public Health" will be held.

On Friday, January 1, there will be held a celebration of the one hundredth anniversary of the birth of Charles Darwin and of the fiftieth anniversary of the publication of the "Origin of Species." This will consist of a morning and afternoon program of addresses by prominent naturalists, to be followed by a dinner at night at which further addresses will be made.

A railroad rate of one fare and three fifths for the round trip, on the certificate plan, has been granted by the Trunk Line Association, the New England Passenger Association (excepting via N. Y., Ont. and W. Ry., the Eastern Steamship Company and the Bangor and Aroostook R. R.), the Eastern Canadian Passenger Association and the Central Passenger Association. The Western Association has on sale revised one-way fares in effect to Chicago, Peoria and St. Louis, with the understanding that persons can repurchase from these points and take advantage of any reduced fares that may be authorized therefrom. The fares to Chicago, Peoria and St. Louis

from a large part of the Western Passenger Association territory are now on the basis of two cents per mile; hence, with the reduced fares from the three cities named, the net rate amounts practically to a rate of a fare and three fifths for the round trip. A rate of a fare and three fifths has also been requested from the Southern and the Trans-Continental Passenger Associations, but decisions have not yet been received.

The Belvidere Hotel will be the hotel headquarters of the association. The Stafford and the Rennert and probably other hotels will be the headquarters for some of the affiliated societies.

There will be printed in SCIENCE next week a list of the societies that will meet during convocation week. In addition to those printed previously, the following notices in regard to these societies have been received:

AMERICAN SOCIETY OF ZOOLOGISTS

THE annual meeting of the Eastern Branch of the American Society of Zoologists will be held at Baltimore, Md., December 29, 30 and 31, 1908. By constitutional provision of the American Society of Zoologists this is also the regular triennial meeting of the Eastern and Central Branches, and therefore, since the joint meeting falls this time in the territory of the Eastern Branch, that branch will act as host. Members of the society are urged to send the titles of their papers to the secretary of the Eastern Branch not later than December 5, so that a preliminary program may be issued about December 10. It will be necessary to place the papers received after that date at the end of the list. Nominations for membership, accompanied by full statements of the qualifications of the candidates must be in the hands of the secretaries before December 1, in order that the list may be submitted to the executive committee of each branch before the meeting. Nominations for membership in the Central Branch should be sent to Professor Thomas G. Lee, Acting Secretary, University of Minnesota, Minneapolis, Minn. Nominations for membership in the Eastern Branch should be sent to the undersigned.

LORANDE LOSS WOODRUFF,
Secretary, Eastern Branch
YALE UNIVERSITY,
NEW HAVEN, CONN.

THE AMERICAN SOCIETY OF VERTEBRATE PALEONTOLOGISTS

THE next meeting of the American Society of Vertebrate Paleontologists will be held at Baltimore, December 28 to 30. The winter meetings of the Geological Society of America and the American Association for the Advancement of Science will be held at the same time and place. The meeting in conjunction with these societies is especially important, as the question of the future affiliation or relationship of the vertebrate paleontologists will be brought before the society by the committee appointed last year, and decided at this meeting. In addition to other advantages, members of the American Society of Vertebrate Paleontologists will have convenient opportunity to visit Washington either before or after the meetings and to examine the great collections of the National Museum.

W. D. MATTHEW,
Secretary-Treasurer
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK

GEOLOGICAL SOCIETY OF AMERICA

THE twenty-first annual meeting of the Geological Society of America will be held in the rooms of the geological department of Johns Hopkins University, Baltimore, December 29–31, inclusive, in affiliation with the American Association for the Advancement of Science. The regular circular of information will be issued shortly. Fellows intending to offer papers for reading are urged to send to the secretary without delay for the regulation blanks for the entry of title. Arrangements have been made in conjunction with Section E of the association for a symposium on correlation which will add greatly to the interest and value of the meeting.

E. O. HOVEY,
Secretary
AMERICAN MUSEUM OF NATURAL HISTORY,
NEW YORK

AMERICAN PHYSIOLOGICAL SOCIETY

The American Physiological Society will hold its twenty-first annual meeting in Baltimore during convocation week, beginning December 29, 1908. Joint sessions will be held with the American Society of Biological Chemists and with Section K—Physiology and Experimental Medicine—of the American Association for the Advancement of Science. The place of meeting will be the Lecture Hall, second floor, of the Johns Hopkins Medical School Building (Washington and East Monument Streets).

Reid Hunt,
Secretary

25th and E Sts., N. W.,
Washington, D. C.

THE AMERICAN NATURE-STUDY SOCIETY

One session of the meeting at Baltimore will be devoted to a discussion of "The Relation of Nature-study and Elementary Agriculture in Rural Schools," and one session will be devoted to "Nature-study in its Relation to High School Biology." It is expected that a third session will be made up of general papers. The dates of these sessions will be arranged, as far as possible, to avoid conflict with other meetings.

THE HAYDEN MEMORIAL MEDAL

The Academy of Natural Sciences of Philadelphia has conferred the Hayden memorial gold medal for 1908 on John Mason Clarke, the state geologist of New York, in recognition of his distinguished services to geological science.

The academy accepted in 1888 from Mrs. Emma W. Hayden an endowment of a memorial to her husband, Dr. Ferdinand V. Hayden, who was for several years director of the Geological and Geographical Survey of the Territories, remaining one of the four principal geologists of the United States Geological Survey from its organization, in 1879, until his death. Provision was at first made to confer a bronze medal and the balance of interest on the fund annually as a recognition of the best publication, exploration, discovery or research in the sciences of geology and paleontology.

The bronze medal was awarded annually until 1899, when the deed of trust was modified so as to provide for the conferring of a gold medal once every three years.

The recipients of the award have been as follows:

1890. James Hall, state geologist of New York.
1891. Edward D. Cope, distinguished paleontologist.
1892. Edward Suess, of Vienna, author of "Das Antlitz der Erde."
1893. Thomas Huxley, the distinguished biologist and paleontologist.
1894. Gabriel Auguste Daubrée, of the Institute of France.
1895. Karl A. von Zittel, of Munich, author of the monumental "Handbuch der Paleontologie."
1896. Giovanni Capellini, of Bologna, president of the Royal Geological Survey of Italy.
1897. A. Karpinski, of St. Petersburg, director of the Geological Survey of Russia.
1898. Otto Martin Torell, chief of the Geological Survey of Sweden.
1899. Gilles J. G. Denalque, secretary of the Geological Society of Belgium.
1902. Archibald Geikie, director of the Geological Survey of Great Britain.
1905. Charles Doolittle Walcot, director of the United States Geological Survey, and now secretary of the Smithsonian Institution.

In the opinion of the committee on the award Mr. Clarke's contributions to geology, especially his "Early Devonic History of New York and Eastern North America," rank him with the others who have received the recognition.

SCIENTIFIC NOTES AND NEWS

Professor W. W. Campbell, director of the Lick Observatory, has been appointed lecturer for next year on the Silliman foundation at Yale University.

On the occasion of King Edward's birthday, the honor of knighthood was conferred on Dr. Jonathan Hutchinson, Hunterian professor at the Royal College of Surgeons; Dr. Thomas Oliver, professor of physiology at

Durham; and Dr. J. J. Thomson, Cavendish professor of experimental physics at Cambridge. The K.C.B. has been conferred on Dr. Donald Macalister, principal of Glasgow University, and formerly lecturer on medicine at the University of Cambridge. Dr. Alfred Russel Wallace has received the Order of Merit.

THE freedom of West Ham has been privately conferred upon Lord Lister at his house in the country, as he was prevented by his state of health from receiving the distinction in public. Lord Lister was born at Upton, Essex, in the borough of West Ham.

SIR DANIEL MORRIS has been elected an honorary life fellow of the Royal Horticultural Society, London.

PROFESSORS HENRY M. HOWE and William Campbell, of the department of metallurgy of the Schools of Mines, Engineering and Chemistry of Columbia University, have been appointed by the American Society for Testing Materials as their representatives on the international committee dealing with the problem of uniform nomenclature of iron and steel. Professor Howe is chairman of this committee.

PROFESSOR SOLON I. BAILEY, of the Harvard College Observatory, who has had charge of the Arequipa Observatory, in Peru, has gone to South Africa, where he has established an observing station about four hundred miles east of Cape Town.

DR. J. E. KIRKWOOD, formerly in charge of botany at Syracuse University and recently associated with Professor F. E. Lloyd in Guayule investigations at Mazapil, Mexico, has taken up his residence at Tucson, Arizona, where he will complete some investigations on desert problems at the Desert Botanical Laboratory, and where he may be addressed.

MR. ABBOTT H. THAYER, the American artist and naturalist, has been giving at the Zoological Gardens, London, demonstrations of the obliterative effect of the patterns where the coloration is supposed to be conspicuous.

DR. E. B. POULTON, Hope professor of zoology in Oxford University, will give the annual address before the Entomological Society of America at its Baltimore meeting, on Thursday evening of convocation week, December 31. The title of the address will be "Mimicry in the Butterflies of North America."

THE Founder's Day address at the twelfth anniversary of the Thomas S. Clarkson Memorial School of Technology will be delivered on December 1 by Dr. S. W. Stratton, director of the Bureau of Standards.

MR. ROBERT MOND, of London, lectured at the College of the City of New York, on Tuesday, November 10, on "The Mond Nickel Process and the Carbonyls of Iron and Cobalt."

PROFESSOR W. B. CANNON has been elected president, Dr. J. L. Bremer, secretary, and Professor F. B. Mallory, treasurer, of the Boston Society of Medical Sciences.

THE Academy of Natural Sciences of Philadelphia has appointed Dr. Arthur Erwin Brown as its delegate to the University of Cambridge Darwin memorial celebration. Although Darwin became a member of the Dresden Academy in 1857, before the publication of the "Origin of Species," it is probable that to the Philadelphia Academy belongs the honor of having been the first foreign society to accord his great work official recognition. He was elected a correspondent on March 27, 1860, upon the nomination of Isaac C. Lea and Joseph Leidy. To his election Darwin refers appreciatively in a letter to Lyell dated May 8 of that year.

AT the opening meeting of the Linnean Society, held on November 2 at Burlington House, the president, Dr. Dukinfield Scott, announced that the council had arranged to present a silver copy of the Darwin-Wallace medal to the British Museum. He handed the gift to Mr. H. A. Grueber, keeper of the coins and medals, who, on behalf of the trustees, acknowledged it. Professor Dendy, F.R.S., the zoological secretary, exhibited the memorial medal founded by the New Zealand Institute in honor of the late Captain Hutton, F.R.S., who did so much to promote the study of natural science in the dominion.

THE memorial tablet unveiled to the late Major James Carroll at the University of Maryland on October 11 bears the following inscription:

JAMES CARROLL,
M.D., 1891, and LL.D., 1907.
Major and Surgeon, U. S. Army.
Born in Woolwich, England, June 5, 1854.
Died in Washington, D. C., Sept. 16, 1907.

As a member of the Army Commission, which succeeded in demonstrating the mode of conveyance of yellow fever, he became an eminent contributor to science by his investigation, and a heroic benefactor of his country and of mankind by voluntary submission to the bite of an infected mosquito, whereby he suffered from a severe attack of yellow fever produced for the first time by experiment.

Greater love hath no man than this, that a man lay down his life for his friends.

Erected by the regents of the University of Maryland.

A COMMITTEE has been formed to erect a monument to Dr. Cornil, former professor of pathological anatomy at Paris. It will be placed in his birthplace, Cusset, near Vichy.

DR. JAMES FLETCHER, of the Experimental Farm, Ottawa, Canada, well known for his important contributions to entomology, has died at the age of fifty-six years.

MR. W. S. HARWOOD, the talented author and magazine writer, died at his home in Los Gatos, California, on November 3. Mr. Harwood was born in Charles City, Iowa, 51 years ago. Among his writings are "New Creations in Plant Life, or Life and Works of Luther Burbank," "The New Earth," and his latest work, "The Life and Letters of Austin Craig," now in the press of the Fleming H. Revell Company.

As the result of a surgical operation, performed too late to save his life, Alvah Augustus Eaton, well known to botanists as a faithful student of the genera *Isoetes* and *Equisetum*, and as a close observer of the ferns, died at his home in North Easton, Mass., on the twenty-ninth day of September, 1908. Mr. Eaton was a skillful plant collector and in three excursions to Florida in behalf of the Ames Botanical Laboratory made many interesting discoveries of importance to American botany. During the last five years of his life he was actively engaged in work on the Orchidaceæ. His herbarium of *Isoetes* is, at his request, to be deposited among the collections of the Missouri Botanical Garden at St. Louis, Mo.

M. ALFRED DITTE, the distinguished French chemist, has died at the age of sixty-five years.

MR. ANDREW GRAHAM, from 1864 to 1903, first assistant at the Cambridge Observatory, known especially for his work on the Cambridge star catalogue published in 1897, has died at the age of ninety-three years.

SIR HENRY ALFRED PITMAN, registrar of the College of Physicians, London, from 1858 to 1880, and formerly physician at St. George's Hospital, died on November 6. He received his bachelor's degree at Cambridge University in 1831, and celebrated last July his hundredth birthday.

WE regret also to record the deaths of Dr. John M. Thome, director of the Cordova Observatory since the retirement of Dr. Gould; of Dr. Cecil G. Dolmage, known for his writings on astronomy; and of Mr. Archibald J. Little, who did valuable geographical work in the interior of Asia.

IT is announced that the cost of the new library building for the Medical and Chirurgical Faculty of Maryland will be $88,000, and of this about $63,000 has already been subscribed.

MR. W. K. DAVEY has given the sum of £1,000 towards the initial expenses of the Australian Institute of Tropical Diseases shortly to be established at Townsville, North Queensland.

PLANS for a new Norwegian polar expedition were described by Captain Amundsen at a large meeting of the Geographical Society held at Christiania on November 10, and attended by the King of Norway. Captain Amundsen's plan is to go with Dr. Nansen's old ship the *Fram* to Cape Barrow, the northernmost point of Alaska, and thence north. The ship will drift with the ice across the Polar ocean. The voyage is expected to last five years.

THE National Conservation Commission will hold its first full meeting at Washington on December 1. At that meeting the first steps will be taken toward putting into tangible shape the results of the six months' inventory of the country's waters, forests, lands and minerals. One week later, after the commission has gone over the inventory, it will hold a joint meeting in Washington with the governors of the states and territories, or their representatives. At this meeting the inventory will be further discussed and the report which the president has requested the commission to make to him by January 1, will be formulated.

ACCORDING to a press despatch, the International Institute of Agriculture, which was proposed by Mr. David Lubin, of San Francisco, to King Victor Emmanuel, inaugurated its labors in Rome, on November 16, by a meeting attended by delegates from forty-six of the countries that have signified their participation. A plan of organization has been prepared, and this, together with a budget, was submitted to a general meeting on November 26. The United States is represented by Ambassador Griscom, Mr. David Lubin, Dr. C. C. Clark, Mr. W. F. Hill, Mr. G. K. Holms and Mr. William Stuart. After the speech by the president, Senator Faina, Mr. Lubin delivered an address in which he outlined the constitution of the institute.

THE daily papers state that Dr. Alexander Graham Bell has completed the frame of his new aerodrome. The *Cygnet,* which made a successful ascent last year with the late Lieutenant Selfridge as aviator, was composed of 3,393 tetrahedrons, while the new aerodrome, constructed on practically the same lines, will have 5,000 tetrahedral cells. It is said to be the intention of Dr. Bell to make a trial flight the first week in December. It is planned to place the machine on a platform holding between two motor boats. They will run up into the outer Bras d'or Lake, and when a speed of eighteen knots has been attained, the aerodrome will be released. Mr. W. F. Baldwin, chief of laboratories for Dr. Bell, is reported to have said that the experimental bureau at Hammondsport, N. Y., is about to make experiments on Lake Keuka, where an airship will be propelled by its own motors over the surface of the water to get sufficient speed to expand its wings. The machine will be attached to light canoes, which will be carried by the airship as it leaves the water on its flight.

FOREIGN papers state that M. Barthou, the French minister of public works, announced in the senate on November 5 that the sum of £4,000 is to be devoted by his department to the encouragement of aerial locomotion. The International Sporting Club, of Monaco, has offered the sum of £4,000 to be competed for at an international aeronautical meeting to be held at Monaco from January 24 to March 24, 1909. The length of the course will be about six miles. The first prize will be £3,000. On November 6 an inaugural meeting of the new Aeroplane Club was held in London, when it was decided to form a club devoted to the development of aerial navigation by machines heavier than air.

PUBLIC lectures in the department of chemistry, College of the City of New York, have been arranged for the current session as follows:

November 20—Professor Bradley Stoughton.
December 4—Dr. Wm. McMurtrie.
December 11—Dr. A. von Isakovics.
January 8—Professor V. Coblentz.
January 15—Professor M. Loeb.
February 19—Dr. R. W. Moore.
February 26—Mr. M. Toch.
March 5—Dr. A. P. Hallock.
March 12—Professor A. B. Lamb.
March 19—Dr. Harvey W. Wiley.
March 26—Dr. H. S. Miner.
April 2—Dr. Wm. J. Schieffelin.
April 23—Dr. M. Wallerstein.

THE department of archeology, Phillips Academy, announces the following free lectures to be delivered in the lecture hall of the archeology building at 8 o'clock.

October 27—"Games of the American Indians," Warren K. Moorehead.

November 17—"Five American Nations; Conquerors of the Snow, Forest, Mist, Desert and Plains," Professor Harlan I. Smith.

December 8—"The White Races," Charles Peabody.

January 12—"The Metal Ages," Charles Peabody.

January 26—"Lewis and Clark Expedition to the Head of the Columbia," Warren K. Moorehead.

February 9—"Lewis and Clark Expedition to the Pacific," Warren K. Moorehead.

February 23—"Caves at Home and Abroad," Charles Peabody.

March 9—"Social Life of the American Indians," Warren K. Moorehead.

March 23—"Lake Dwellings and the Bronze and Iron Cultures," Charles Peabody.

April 13—"Origin, Accomplishments and Destiny of the American Indians," Warren K. Moorehead.

UNIVERSITY AND EDUCATIONAL NEWS

At the annual Michigan Union banquet at the University of Michigan Mr. Clarence W. Barbour, representing the Michigan alumni in New York, announced that plans had been perfected and funds subscribed for the erection of a $300,000 dormitory, with a large "commons."

The H. K. Cushing Laboratory of Experimental Medicine at Western Reserve University was dedicated on the afternoon of November 20, when Dr. H. W. Welch, of the Johns Hopkins Medical School, made the principal address. The building, complete in all its appointments, is of reinforced concrete, faced with brick. It is 55×40 feet, and consists of four floors. On the first floor is a large room for chemical work, and in connection with this is a balance room, the balances being arranged on a solid concrete pier. A workshop, a store room, a dark room for photographic purposes, and for the reception of a centrifugal, complete the accommodation on the first floor. On the second floor is the library, and one large and several small rooms for individual investigations. Also, a refrigerator room, a room for maintaining a constant temperature and a chemical store room. The third floor has several rooms for students, and the fourth rooms for the study of nutrition in animals under the influence of different diets, with a view to throwing light on the diseases of nutrition in man. The building is practically fireproof. The laboratory is named for Dr. H. K. Cushing, who was for many years associated with the Cleveland Medical College, which later became the medical department of Western Reserve University. Dr. George N. Stewart is professor of experimental medicine and director of the laboratory.

The Rev. Dr. W. A. Shanklin, president of Upper Iowa University, has been elected president of Wesleyan University.

Dr. Frederic E. Farrington, who spent last year in France, studying especially the secondary schools of that country, goes this year from the University of California to the department of education in the University of Texas. In the latter institution he occupies the newly-established chair of associate professor of education in charge of the observation and practise of teaching.

Dr. Stanley R. Benedict, formerly assistant in physiological chemistry at Yale University, has been appointed instructor at Syracuse University.

Howard Lane Blackwell, Ph.D., has been appointed fellow for research in physics at Harvard University.

DISCUSSION AND CORRESPONDENCE

SIDE ISSUES BEARING ON THE AGE OF NIAGARA FALLS

In a late issue of Science (July 31, 1908), a notice of my recent book upon Niagara Falls was published by Dr. G. K. Gilbert,[1] which is chiefly a discussion of three minor problems, the treatment of which could scarcely be considered a necessary digression from the main issue of my book. In his dealing with these, a doubt is left as to the correctness of my conclusions regarding the age of Niagara Falls; and a substitution is given in his own behalf, announcing, without the evidence, that their duration is more than four times that of my computation, which computation was based upon the most carefully measured details of the work accomplished during each stage of the physical changes of the river. This correspondence is cordially welcomed in that it renews the interest in the subject, for as Professor James Geikie has

[1] "Evolution of the Falls of Niagara," by J. W. Spencer, pp. i–xxxi, 1–490, Geological Survey of Canada, 1907.

somewhere said—when controversy ceases the interest passes away, and the truth generally lies between the extremes. The value of the points raised must be taken in their magnitude relative to what has already been established in the investigations of Niagara Falls; accordingly, a backward sketch of some of the results must be made.

Years ago Dr. Gilbert presented data, in mathematical form, demonstrating that the Falls were no more than 7,000 years old, with several modifications tending to lower even this estimate (page 372). Shortly afterwards, my discovery that the Huron discharge had formerly nothing whatever to do with Lake Erie, or the Niagara (page 294, also Chap. XXV., and Ap. VII.), changed the then new idea of the short age of Niagara Falls. This now universally accepted fact is further proved by new soundings (pp. 71, 73), within and without the end of the gorge, bringing to light a narrow deep inner channel that could carry only the Erie drainage. The same phenomena I also found in the expanded reaches of the St. Lawrence River (Chap. XXIX.). Furthermore, the drowned channels among the swamps of Lake St. Clair furnished additional proof of the original northward discharge of the Huron waters (Chap. XXVI.).

From the structure of the terraces at Foster's Flats (Chap. XIV.), and the excavated depth of the channel above them (p. 66), I have been able to establish the location of the falls when the discharge of the Upper Lakes was added to the early Niagara River. In soundings and borings, the nature of the gorge at the Whirlpool Rapids has at last been revealed (Chap. V. and XII.). My soundings under the falls, the only ones that have ever been made (p. 56) have brought to light the reduced depth of the basin beneath (p. 48). This was exceedingly important, as it revealed the recent damming of the channel, which raised the level of the river in the basin just below the great cataract, thereby shortening the otherwise calculated age of Niagara Falls, while they were receding the last three miles, by thirty per cent.

The ancient volume of the river has been computed on a sound basis at fifteen per cent. of the full discharge of the four Upper Lakes, an amount closely agreeing with that previously calculated for the Erie drainage by Mr. Thomas Russel (U. S. Lake Survey), his result being 16.7 per cent. (p. 252). These and other features, such as the origin of the Upper Rapids (p. 166 *et al.*), dependent upon preglacial phenomena, cover some of the most important changes in the complex history of the cataract, all of which show that the energy of the falls has increased tenfold, or 1,000 per cent. This increased power is not questioned, but established.

Per contra, my critic raises three points, the relative importance of which will be seen upon the examination of each. One of these is the relative "efficiency," or, in other words, what has been the loss of work during the changing energy of the cataract. He says: "To say that the rate of recession is proportional to the energy is equivalent to saying that the efficiency does not change with the variation of energy," but in my statement I added "provided other conditions remained constant" (p. 350), and my whole book is a differentiation and measurement of the changing conditions. To the paragraph, just quoted from the review, my attention was called by a layman. His omission of the word "relative" before efficiency left on the layman's mind an impression that the critic fallaciously supposed that I had made a fundamental error. As the word efficiency is repeated a score of times, the science of the falls demands investigation of the point raised. He urges a comparison of the relative efficiency of the changing energy of the falls with a man-made engine, and says that "the computed energy of the American Falls does not differ greatly from the computed energy of the main cataract during the longest division of its history." Let me say that the now measured discharge shows that during the earlier period the volume of the main cataract was three times that of the American Falls of recent origin.

If we are to seek analogies, let it be noted that the kind of man-made engine most nearly approaching a waterfall is a water-wheel or turbine, though it is not so stated. Rankine,

whom he quotes, mentions that in numerous trials the efficiency of different wheels varied from 66 to 80 per cent. The loss actually questioned is the difference between these figures, which shows that the relative work performed by the worst machine is only 17.5 per cent. below that of the best. In the turbine wheel there is a loss from leakage as well as from friction, which does not occur in the natural falls, where, however, there is wind effect. As the American Falls represent 200,000 gross horse-power, which is very much greater than any turbine, the relative loss of power should be very small compared with even the best engine. In testing the relative loss of power in turbines, Kent[2] mentions that in diminishing the supply of water to half the flow, in one kind of turbine, the useful work fell six per cent. only. This is the best kind of illustration for comparing the efficiency of the changing volume of the cataract with a man-made engine. The loss of work to the extent of six per cent. in the American Falls over that of the Canadian, due to smaller volume, would cause only an increase in the computed age of Niagara Falls of less than 2,000 years (or a difference in efficiency of ten per cent., would add less than 4,000 years) in excess of the 39,000 years. This only possible increase, if not counteracted by other minor elements, is provided for in the anticipated variation of ten per cent. (p. 369). The smallness of the variation suggested is better appreciated when it is compared with the discoveries of increased energy (1,000 per cent.), which has raised the supposed age of the falls from less than 7,000 years (Gilbert, formerly) to 39,000 years (Spencer).

However, if any allowance should be made, as above set forth, there is another physical component of about equal importance, the effect of which would counterbalance any relatively inferior efficiency of the smaller falls. Both are small factors compared with the great changes of energy discovered.

The second point raised is a plea for measuring the age of the whole gorge on a basis of the recession of the American Falls. He says: "The American Fall does not differ greatly from the computed energy of the main cataract during the longest division of its history," and further states that if I had used these falls for the basis of my calculations (or a formerly provisional rate based upon incomplete data obtained from measurements made in 1868, since abandoned for complete ones), the age would have been nearer 20,000 than 39,000 years, but I may say that with the full treatment of the subject, from even the partial data published, any one would have found the computation to have reached 32,000 years. But no computations based on the American Falls were attempted by me. He also says with regard to the recession of the American Falls: "It may with confidence be said that 0.06 foot a year [in recession] is nearer the truth than 0.60, but no definite estimate is warranted." This latitude in comparison reaches 0.32 foot (thirty-two hundredths), which appears to be what he meant, because in his official bulletin,[3] page 22, he gives this figure as one of his conjectures, but in the controversy one would think that he meant little more than the lesser amount (0.06). Using his coefficient of 0.32 foot, the age of Niagara would be over 37,000 years (not 20,000 years).

In my Niagara book, I stated that the American Falls had receeded 0.60 foot between 1842 and 1890, which was true for that period. More recent surveys show that afterwards, down to 1906, no further important changes had occurred. Thus the measured rate is reduced to 0.47 foot a year. This must be further diminished to 0.35 foot in comparing the work with that of the Canadian Falls. The mean total longitudinal recession has been only 29 feet since the first measurements were made, while that of the greater cataract has been 265 feet, and the discharge measurements show that it carries 95 per cent. of the volume of the whole river.

The recession is intermittent; in the one case the amount is so small that we do not know whether the cycle has been completed during the period of observation or not. Here a small error from any cause would prevent

[2] Kent's "Engineering Pocket Book," p. 596.

[3] Bulletin U. S. Geological Survey, No. 306, 1907.

the estimated rate being of more than approximate value. In the case of the main cataract, there have been many cycles, so that an error in one is not fatal to the determination of a mean rate.

In his recent report upon the recession of Niagara Falls,[4] Dr. Gilbert devotes much space in trying to prove as erroneous Professor Hall's survey (1842), which shows a shelf since fallen away. Without discrediting Hall's work, it seems much more probable that a cycle of undercutting had commenced prior to his survey, though the floor of the river fell afterwards, so that his measured amount of recession belongs to a longer period. The protruding shelf shown by Hall is also indicated on the map of the International Boundary Survey of 1819. On this basis the mean rate would be reduced to 0.34 foot (or for comparative purposes to 0.26). It we were to estimate the rate of recession of the smaller cataract in terms of the greater, it would be 0.28 foot a year (or for comparison, 0.22 foot). On the basis of 0.34 foot, the age of the Falls of Niagara would be found to be 37,000 years, which nearly approaches that already stated in my book. If 0.28 be taken, the result would of course be the same as that based on the main cataract. Conclusive measurement could not be made during a lifetime, besides which the spoliation of the cataract for power purposes will destroy the natural conditions; yet additional data are obtainable, so that it will be possible to write a supplementary chapter on the recession of the American Falls, now that the collateral evidence is called for.

There are other factors in the physics of the falls of differential value, but they are all embraced in the actual work done by the two cataracts, the relative efficiencies of which do not greatly differ, as shown above, upon the problem being analyzed scientifically. This opportunity of confirming my previous calculations affords me great satisfaction.

As to the recession surveys of Niagara Falls, it may be stated that mine of 1904 was the fifth one of the main cataract ever made (Preliminary Report of the Geological Survey of Canada for 1905, published in the summer of 1906), preceding by a few months that of Mr. W. Carvell Hall. In using this last-mentioned survey, Gilbert computes his rate of recession from only that portion of the falls where the greatest depth of water occurs, although that portion is some hundreds of feet less than the diameter of the cataract which has been making the gorge of an equal width. In his calculation, he also uses the mean of ordinates unequally placed. Thus he gives a result of 5.3 feet a year, but on page 25 he adds that there is an uncertainty of one foot. This estimate of five feet a year affords no coefficient of recession throughout the gorge. If corrected for the full width, the rate would be found to approximate that of mine. He also says that the recession between 1875 and 1905 was greater than in the previous thirty-three years; but had he broken up the former period into two divisions of fifteen years each, he would have found a great reduction in the rate of recession during the latter fifteen years. In his application of the rate of five feet in determining the recession of the American Falls the result would give too short a time, had there not been a previous acceleration, due to the higher stage of the cataract during its earlier history (unknown until discovered by my soundings under the falls). These compensating omissions, however, give an approximately acceptable rate (0.32 foot).

Thirdly, my critic says:

> If the efficiency of Niagara in producing recession varies according to the law, as the efficiency of a river in transportation, Spencer's estimate of the age of the river should be multiplied by a factor larger than four.

Lake Erie is a settling basin, so that only after occasional severe storms does the lake send down its turbid waters into Niagara River, and then only for a short time, but this small quantity of detritus, even then, varies with the volume and velocity of the river and is lost in the general averages of the discharge measurements. The volume of detritus removed from the channel of the river since its birth is less than a thousandth part of the volume of water that flows down each year. Again, it requires 900 tons of water to loosen every pound of rock carried

[4] Bulletin cited before.

away from the gorge in the recession of the falls, which is occasioned by the undercutting in the soft strata, and not by the abrasion from an infinitesimal quantity of detritus. The capacity of streams for transportation varies as the sixth power of the velocity, while the erosion varies only as the square of the velocity. I do not understand the ground for comparing the clear-water Niagara with the experiments based upon transportation of muddy water of other streams. But we can get an inkling as to the relative abrasion at Niagara. Only since the falls have receded the last mile and a half have the Upper Rapids come into existence (1,500 years ago or less). In the meanwhile the river, with its dissolving waters, ice, detritus and currents, has not made any true channel next to the head of Goat Island, while at the foot, after the rapids have descended over fifty feet, all of these forces together have only cut in the rock to a depth of four feet—and this while the falls have been receding a mile and a half. If the recession were proportional to the detritus, which he assumes as ground for quadrupling my computations, we should certainly have to raise his conjectural age into millions of years. The proposition of measuring the work of Niagara Falls by transportation of detritus is certainly irrelevant.

Concerning the soundings, it is further stated that my apparatus was of the Kelvin type. This statement requires correction. That used by me was invented and patented by Lieutenant Blish and Commander Tanner, officers of the U. S. Navy. It is entirely a different and better device for recording the depths than that of Kelvin, whose instrument could not have been used in fresh water. Commander Tanner kindly lent me some of the apparatus.

Dr. Gilbert says:

> But while the discovery of the real law of efficiency would be a notable contribution to the problem, it would not remove every difficulty. In its proper application there would be need to take account of various qualifying conditions, not all of which are easily evaluated.

He then specifically mentions five. Here indeed I not only accept his conditions, but I did anticipate them, giving the most detailed measurements of them, with many sections drawn to scale, and other illustrations. These I shall take up consecutively.

(1) "Width of gorge as affecting quantity of erosion," and I may add depth. These subjects are fully discussed, with numerous sections determined instrumentally, in chapters V. to X. and parts of XII. and XIV. (2) "Depth of the gorge from the crest of falls to bottom of pool." This has been measured for the first time, by me, and described in a headed page (56), figured section (p. 48), further explained (p. 86), and applied in calculations (p. 367). (3) "Concentration of flow as affecting efficiency." This is discussed, in relation to points raised, in chapters IX., XII. and XIV. (and p. 368). (4) "Thickness of the capping limestones as affecting efficiency." This is shown in tabular form at many points (p. 90), in many figured sections (Chap. VIII. and pp. 50, 343), and in other references and with a time allowance (p. 369). (5) "The relation of the Medina sandrock to efficiency." A table is shown to illustrate this (p. 90), also many figured cross-sections (Chap. VIII.) and longitudinal ones (pp. 50 and 343). These show that the Medina sandrock had no relationship whatever to the uppermost cataract upon which was based the recession during the first 35,000 years, and in the last 3,500 years, to only an infinitesimal amount. These features may be redescribed by others, but any student will find all of them described in my book as nowhere else, many for the first time, which will furnish him with data for working out specific problems that I may have deemed immaterial. Finally he says that "Spencer's computations do not include data bearing upon these variables." I am surprised that any one should have read my book and failed to take account of the distinct and articulate chapters, headed paragraphs and illustrations, covering all of these points. He also mentions my discussion of the present stability "of the land in the Great Lakes region, with the conclusion that no earth movements have occurred in modern times," without further comment, as

if concurring with me, when here I should have expected dissent, as the results are at variance with his former opinion.

In my book upon the Falls of Niagara, I have set forth the data found in my researches, by which their changing history has been discovered. The age of the falls is a very interesting, though secondary, problem. My observations may be repeated by others, with variations in treatment. The leading points raised by Gilbert are variations in treatment, of magnitude relatively small; and a third (that upon which he indicates his belief in their great antiquity) rests upon inadmissible analogies. All of these points, though tending to divert attention from the main issues, in reality confirm my conclusions. I have no theory as to the length of time to defend, except that which is suggested by the changing physical conditions, as measured by the falls, in the gorge and in the volume and height of the cataract, and as I have said in my book, a matter of a few thousand years does not make an important variation in the value of my pioneering work "in the correct line of investigating the problems presented by this remarkable region." I am pleased that my critic thinks that the determination of the age of Niagara lies within the scope of observation, and is of so much popular and scientific interest.

J. W. SPENCER

WASHINGTON, D. C.,
November 1, 1908.

THE QUESTION OF PROFESSORS' SALARIES

THE statement is sometimes made, that a general increase in the salaries of college and university professors would be of no service to the institutions concerned, in improving the character of the men available for professorships. I believe this view to be incorrect, especially as concerns our colleges; and I venture to present the following suggestions for the consideration of those who hold it.

A general survey of the institutions of learning, large and small, throughout the land, leads to the painful conclusion that our faculties no longer, as they once did, represent groups of cultivated men. The word "culture" has of course fallen into disrepute in our day; but the cultivated man, while we no longer aim to produce him, demands and receives our respect and admiration wherever he is found. It would not be difficult to cite a few notable survivals of the type here and there. The rarity of teachers of this kind in our college and university faculties to-day will be readily admitted by all who have any intimate knowledge of the matter. Yet the desirability of having such men as instructors of undergraduate students is keenly felt by those who have to choose a college for their sons. The function of the undergraduate course is precisely to give the student what he will not get when as a graduate he enters the special field of his life work; therefore the undergraduate course should give the student a general enrichment of life; which is exactly what we mean by cultivation.

But we are content at present that the highest product of our educational system should be the specialist; a man usually thoroughly conversant with one small branch of learning, and fairly well acquainted with some allied subjects, but often ignorant in every other field of human interest, without ideas of his own in any field but his own, and dead to everything that can be classed as the amenities of life—the arts, literature, human society.

I venture to suggest that our specialist is a man of this kind because he comes from a home which lacks those things of which we now deplore the absence in him. Then why do our institutions of learning draw from such a class of material? They have no choice; and for this reason: the youth who decides on the teaching profession as his career must of necessity abandon the idea of accumulating money; that surely no one will dispute; and there are many who are willing to accept this as a condition of their existence. But very few are willing to abandon the ambition for wealth as an aim in the future, and at the same time to accept a present and permanent reduction in their scale of living. For the ambition not to be rich makes for happiness about as well as the ambition to be rich; but it does not make for happiness to

have to get along in life without comforts and reasonable pleasures that have hitherto been within our reach. A cutting down of the scale of living is one of the sources of real suffering.

Hence if we take, say, $2,000 as the average salary of our college professors, we may say that on the average our professors will be drawn from homes where the scale of living is adjusted to the same figure, or a little more. But the children in such homes have, in our day, few of the advantages of life—few books, little or no travel, perhaps one may say without offense, little social experience. That was not so a generation ago, when salaries were about the same, but the scale of living totally different. Nowadays the college professorship offers no material inducements except to those who have been brought up in a pretty severe economy, and who can get from it all the comforts to which they have been used, and perhaps something more, with often an added pleasure in a certain prestige, which is attractive. Many will say that the self-made man is the grandest type of manhood we can put before our young men, etc. But the self-made man, admirable and effective though he often is, is rarely a cultivated man, and therefore can not give us all of what we want in the college teacher. And then, the self-made men on our faculties have so rarely finished the job.

Now a general rise in salaries would, I think, make it possible for our undergraduates to have for their intellectual guides not men who merely know immeasurably more of Latin or of botany than do the students themselves, but men who bring with them fine traditions of cultivated living and of "high thinking," a wide experience of life and humanity. It should, therefore, be the aim of the college to pay such salaries to its professors as would enable them to give to their own children what the college would regard as a perfect preparation for professorial work. Only in this way can it draw its teachers from a class in which such preparation is possible.

The graduate student has totally different needs, and in the university there should be found room for both types of teachers, the man of cultivation and the man of knowledge. Of these two the latter is more necessary to the advanced student than the former. I believe it is equally true that for the younger student, the man of cultivation is more necessary than the man of knowledge.

Everything depends, however, on the point of view, and no one can recognize more clearly than the writer that his own is hopelessly old-fashioned; though in a time that we regret and admire it was almost universal.

S.

SCIENTIFIC BOOKS

Life and Letters of Herbert Spencer. By David Duncan, LL.D. 2 vols. 8vo, pp. xiii + 414; vii + 444. New York, D. Appleton and Company. 1908.

Obviously enough, it is impossible at this early date to offer a just estimate either of Spencer the man, or of his "synthetic philosophy." "The Autobiography," covering sixty-two years of its author's life, and the volumes now before us must always serve, nevertheless, as primary sources for that more objective appreciation to be undertaken, doubtless, after the lapse of years. In these circumstances, and in this journal, I shall confine myself to certain points suggested by the "Biography," and eschew excursions farther afield.

The contents of Dr. Duncan's work are as follows: (1) Twenty-eight chapters of strict biography, filling the whole of Volume I., and 245 pages of Volume II. The method employed is to rely largely upon Spencer's correspondence, and to connect the scattered parts by apposite comments which serve also to fill out lapsed details. I am much struck by Dr. Duncan's admirable restraint in subordinating his own personality, and permitting the events to tell their own tale. (2) Two chapters, entitled, respectively, Characteristics and Personal Reminiscences, and Spencer's Place in the History of Thought; in these the biographer speaks for himself, and, especially in the former, introduces appreciations furnished by intimate friends and familiar acquaintances. (3) Five Appendices, whil fall into two distinct groups. (*a*) Contributions from

Spencer's own pen. Of these the *first* deals with his Physical Traits and some Sequences (written in 1902); the *second* with his intellectual history, under the title, The Filiation of Ideas (written in 1889). In a prefatory note Spencer points out that they really belong to the "Autobiography," but that this book was stereotyped ten years before the first of them was written. The *third* is a three-page unpublished letter on The Nebular Hypothesis (written in 1900). (*b*) *First,* a List of Herbert Spencer's Writings. *Second,* a list of Academic and other Honors offered to Herbert Spencer. I ought to add that I have found Dr. Duncan's volumes much more interesting than the "Autobiography." In fact, they present a complex, in some ways contradictory, personality. Perusal of them can not fail to dispel many current misconceptions; they will also enable the reader to orient himself more readily towards this latest "runner" in the wonderful race of British empirical "torch-bearers." Their wealth of incident will, of course, elicit varying reactions from different minds, and I can only indicate one or two of my own.

Spencer was wont to pride himself upon the non-conformity of his ancestors. Exiles for conscience sake from their old homes on the continent of Europe, they appear to have remained "agin' the government" in the land of their adoption. However this may be, it is of more vital interest by far for us to note that Spencer's own nonconformity can not but have been influenced deeply by the life upon which he looked out. A Saul among the prophets of the dissidence of dissent in religion, in politics and in society, he felt himself commissioned as a kind of supreme critic. His lack of school and university experience left "all his angles acute," while his career, after 1878, *dans le mouvement* at London, seems to have been too belated to work radical alteration. Had the Royal Society elected him in 1853, when Huxley introduced him to Tyndall for the first time in its rooms, he would doubtless have welcomed the recognition gladly. But, as he thought afterwards, in 1874, the courtesy arrived over-tardily. I incline to believe that much of his contrariness must be sought deep down in the nature of the English environment during his active days. The movement, so marked since, whereby eminent representatives of science pass readily from their middle-class origins to terms of equality with the "upper ten thousand," had not eventuated. The standards of judgment, inherited from medievalism, that wrote a man down a scoundrel for his matured opinions, still prevailed widely. In a word, the great period of transition from renascence to modern thought was on, and Spencer had the fortune, or misfortune, to be a main instrument in a profound transformation, one by no means over yet, especially in English-speaking lands. Of this he exhibits slight awareness, and the continuous friction serves to confirm incipient idiosyncrasies. His influence upon the philosophical trend in Britain after J. S. Mill's death, say, has remained slight; his public in the United States was constituted sooner, and has always been larger. These straws show how the wind blew; and he felt the chill keenly, even if he never perceived the causes. Or, to put it otherwise, his career must be read in the light of the contemporary religious, social and philosophical situation in England. He tended naturally to dissent, and regnant moods of his contemporaries served to intensify this leaning. Remembrance of this will help to explain not a little. For, as he records himself, he was at odds with his countrymen.

A further indication of the unstable condition of the intellectual world may be traced in Spencer's morbid fear lest he should be accused of elaborating any ideas save his very own. I have noted no less than fourteen references in point (I., 128, 147, 185, 188, 197, 207, 253, 268, 315, 327, 342; II., 90, 168 f., 212). Be it Comte or Darwin, Rousseau or Tylor, he will acknowledge no obligation; nor does he relish that Maudsley, or Clifford, or Lockyer should, as he supposes in evident good faith, trade upon his ideas, and amass reputation while he goes supperless to bed. His unhumorous punctilio in these and other matters almost renders Gilbert's whimsies fit commentary;

For he himself has said it,
And it's greatly to his credit,
That he is an Englishman!
But in spite of all temptations
To belong to other nations,
He remains "*the*" Englishman.

The immense transvaluation that occurred during Spencer's life has, I feel sure, as much to do with these curious, unpleasing, and puzzling traits as any mere heritable quality. This appears further in the dogmatic judgments he offers so serenely upon other men. As might be expected, Goethe and Carlyle, Ruskin and Watts and Stevenson, to say nothing of Kant, fare badly; so do Owen and Kelvin, Laveleye and Tylor and Weismann; but even Comte, J. S. Mill and Bain fail to escape the "predestinate scratched face." Justly enough, Calderwood is convicted of "a piece of poor fumbling," and Princetonians will be charmed to know that McCosh's *soubriquet* in his native country (McBosh) is recalled with glee. George Eliot and Victor Carus come through the ordeal unscathed; while of Alexander Smith it is said, "I am strongly inclined to rank him as the greatest poet since Shakespeare"! Neither Tennyson nor Browning, let alone Arnold, merits similar commendation. Plainly, the conflict of the age has determined these curious phenomena quite as much as personal bias.

No less interesting and symptomatic is Spencer's relation to *Facharbeit*. The enemy has affirmed in many shapes, "scratch Spencer and you find ignorance." It were superfluous to comment upon this cynicism. But it so happens that certain facts, full of intimation, do make their appearance, and serve to cast light upon not a few matters. As concerns what we mean by the *English* term "science," Spencer took care to consult with authorities. Consequently, even Darwin is able to write, "I was fairly astonished at the prodigality of your original views." He sought counsel constantly with Huxley and Tyndall; when he dealt with individual ethics, he "solicited the criticisms of married lady friends on whose judgment he could rely"; when preparing for a new edition of the "Principles of Biology," in 1895, he "ordered copies to be interleaved and sent to young biologists, recommended as being familiar with the recent developments of the science"; on questions of physics and geology he referred to Clerk Maxwell, Kelvin, Judd and numerous other experts; when he desired information *re* statistics, he applied to Sir R. Giffen, and so on. But, then, he aimed to rank as a philosopher, not as a scientific leader. What of philosophy, and philosophers, we therefore ask? *Mirabile dictu*, he knew little of Plato, nothing of Aristotle; of Bacon, the "Essays" alone; of Hobbes, not much; of Locke, nothing; of Bentham and Paley, only their most general doctrines, noised abroad by the man in the street; of Kant, nothing; of Mill he read the "Logic," but recorded no more than an attack upon one of its doctrines; Hamilton and Mansel aside, he seems to have been blind or indifferent to the whole movement since Kant; for instance, his single communication to its leading English exponent is a letter on a burning question of party politics! He repudiated expressly all knowledge of Indian philosophy; and, although he was an authority on the philosophy of education, he avers that he never read "Emile." Further, he seems rather proud that he possessed slight philosophical equipment; and yet, he does not protest when friends baptize him "the greatest living philosopher," indeed, one can only infer that he took them *au pied de la lettre*. These extraordinary contradictions are explicable in one way, so far as I am capable of seeing. Spencer was a *Verstandsmensch* and did not know it. It is amusing to find him cling again and again to the outworn eighteenth century standpoint (*e. g.*, I., 232, 235 f., 287, 301, 304; II., 3, 79, 191, 201) and, at the same time, characterize modern idealism as "old-world nonsense." The old-world nonsense nestled between his own covers, despite his evolutionism. As Ferri pointed out, he did not draw the conclusions which evolution warrants, and thus in philosophy, as in other things, he stood rather aside from the main current of his time. Epistemology and logic failed to touch him, and he never attempted the deeps of constructive metaphysics. His constitutional aversion to criticism, and even

to discussion, emphasized all this. So, here too, transition is written large over much of his work. This, more than aught else, explains the defense outlined by the Dean of Westminster, when he refused to entertain the proposal for a Spencer monument in the Abbey. And, as Dr. Duncan does not see (II., 244 f.), Hegel would have concurred, would have trimmed, possibly, upon his famous foot-note about the philosophy of hairdressing. Philosophically, Spencer was fated to be a mighty *Bahnbrecher;* such an one stood in need; and he accomplished the full tale of bricks. Accordingly, it is nowise astonishing that his appeal to philosophers *von Fach* has not been very fundamental. How could it be in the circumstances? Try the case from the scientific side. What would scientific men think of a colleague who comported himself in like manner, and then permitted acclaim as the sole high-priest? Notwithstanding, no one can deprive him of his rightful place as advance agent of evolutionary phenomenology; yet, for this very reason, our generation hesitates to enroll him in the apostolic succession of constructive thought. Further, the same facts indicate why, to this good hour, he has not received more than a modicum of the recognition that he earned so richly. They also account for some of his life-long asperities.

Pleasing glimpses are given of Spencer's relations with his friends, which dispel the wide-spread belief that he was a surly curmudgeon, "all intellect and no heart." Among these, one of the most interesting to Americans can not but be his unclouded friendship with Youmans, the founder of the *Popular Science Monthly.* But, beyond question, the most impressive factor in the personality was the indomitable will whereby, taking up arms against a sea of trouble, the man conquered, and all for the purest of ideal interests. To this battle the history of the race presents few parallels, and it bears a heartening message of encouragement to every worker for the spiritually indispensable, as Carlyle called it finely.

Finally, for the benefit of American readers, a word should be added concerning Dr. Duncan. He is an Edinburgh philosopher, who acted as Spencer's secretary for several years in the late sixties. In 1870, he proceeded to India as professor of philosophy in the Presidency College, Madras. After fourteen years' service, he became principal of this institution. From 1892 till 1899, when he retired, he occupied the important administrative office of Director of Public Instruction for the Madras Presidency. He is known as one of Spencer's oldest collaborators in the "Descriptive Sociology." He seems to me to have performed a task of infinite difficulty, due partly to the reasons outlined above, with admirable spirit and skill. The extreme care with which the book has been produced—I have noted but three trifling misprints—and the thorough, workman-like index, are among our least obligations to his *pietas.*

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Notes on the Development of a Child, Parts 1–4, Vol. I., 1893–1899. The Development of the Senses in the First Three Years of Childhood, Vol. II., July 25, 1908. University of California Publications in Education, Vols. 1 and 4. By MILLICENT WASHBURN SHINN. Berkeley, The University Press. Pp. (Vol. I.) 424. $2.25. Vol. II., pp. 258. $2.50.

Dr. Shinn's first contribution to our knowledge of "the ontogenic evolution of the faculties of the human mind," which Professor Le Conte, in an introductory note to Volume I., describes as the "most important of all possible subjects," was published fifteen years ago as Part I. of the "Notes." (Pp. 88.) This part, after a page of biographical notes and two pages giving measurements of growth in height and weight, consists of data relating to the development of sight in infancy, chiefly during the first two years, and classified under such headings as: sensibility to light, movements of the eyelids and eyeballs, fixation, direction of look, sensibility to colors, color preferences, discrimination of forms geometrical and other, understanding pictures and other representations.

Part II. of Volume I., pp. 89–178, appeared

in 1894. The first fifteen pages of this part continue the notes on the development of sight to the end of the third year. Then follow notes on the development of hearing (sensibility to sound, locating the direction of sounds, recognition and discrimination of sounds, interest in music); the dermal senses (contact, pain, temperature); taste and smell. Parts 3 and 4 of Vol. I., pp. 179–424, appeared in 1899. Pages 179–298 report the author's observations on sensations of muscular activity, motion and position; organic sensations, and general sensation. The remaining pages of parts 3 and 4 are given to reports on various sorts of movements—spontaneous, reflex, instinctive; equilibrium and motion (which is full of data on sitting alone, creeping, standing, walking and running); instincts connected with food-taking, learning to grasp with the hands, and so on. The volume may be described as a rich storehouse of accurate, minute observations relating to the sensory and motor development during the period of infancy.

With respect to the sources, method and purpose of Volume II., the author writes:

> My original data for the following study have come almost entirely from a journal of the development of a single child [the author's niece]. . . . But in the later examination of the data, I have supplemented them with the observations of others. My record was but little guided by any previously formulated theory, or by the effort to solve any previously formulated problem. . . . In the main I aimed only at a scrupulously objective record of the facts of development, as they appeared quite spontaneously.

The data thus collected were classified and published as Volume I. of the "Notes," as indicated above.

The purpose of Volume II. is to summarize and interpret the previously published observations relating to the development of the senses. By "interpretation" the author means tracing "the development of the senses from stage to stage, with reference to the genetic relationship of these stages, and the process by which each unfolds from the preceding"; the search for a general law of this unfolding; the consideration of "the bearing of any results thus reached on current problems of psychology"; and, finally, the author formulates, as corollaries, the pedagogical suggestions of the study.

Of the two methods which have been employed in the study of infancy—the comparative and the biographical—Dr. Shinn regards the latter "thoroughly checked and corrected by comparison" as "the true one for the study of children of the earliest period." Experimental investigation, no doubt, is sometimes necessary, but it is just as well, in the author's opinion, that the study of infancy "should wait a while for any considerable experimental investigation, and should depend for the present on pure observation." The next step is quite easy and natural; namely, to banish from the field of child-study all mere scientists—psychologists and physiologists—and declare child-study to be a new and independent science. And this, in a sense, the author does. She observes that "a deep knowledge of adult psychology," has not been particularly helpful in the study of infancy, and expresses the opinion that the most solid and valuable contributions to our knowledge of babies, so far, have come not from psychologists, but from physiologists." Leaving aside the differences of opinion which may exist as to the relative importance of the contributions of psychologists and physiologists to child-study, it may be said that the *reason* assigned for the statement of the text—that in genetic psychology "the genetic element outweighs the psychologic" (Vol. II., p. 7)—seems to rest upon a curious misapprehension of the province and scope of modern psychology in general, and of the problems and methods of genetic psychology in particular. But, on the other hand, the physiologist, Dr. Shinn believes, can not guide the future of child-study, for he "stops short of the real point of interest in child development, the germination of the higher psychic activities." With the psychologists and physiologists both repelled from this new territory, and no invasions being threatened from other quarters, child-study may be free to develop "in the main its own theoretic basis," (1) by gathering a large mass of data by observation

and limited experiment, and (2) by classifying, comparing and drawing inductions from these facts.

Continuing, the author advances the usual arguments for prefering the inductive method to the method of proceeding, theories in hand, in scientific research. In this connection, Professor Baldwin's well-known "Mental Development in the Child and the Race" is cited as a horrible example of what is likely to happen when an investigation is dominated by preconceived theories. That work, Dr. Shinn says, has failed to supply the theoretic basis for future observations in child-study, "because it has, after all, no close practical relation to that study." However highly the author may value that work on other grounds, evidently she does not hold it in very high esteem as a contribution to child-study.

The author next considers the difficulty of finding a satisfactory principle of classification for the data of child development. The analytic headings "dismember every incident we would report, for the actual development we are tracing is essentially synthetic, yet we must needs analyze, in order to interpret." All in all, a modification of the Spencerian formula for the process of evolution supplies a satisfactory guiding principle—viz., child development is "a progressive movement consisting of the integration of simpler activities into more complex, and the differentiation of specialized ones, out of generalized." The validity of this principle is not discussed, "because the most important part of the following thesis is a contribution to that very discussion."

Leaving the introduction and passing to the body of Volume II., we have the following divisions and sub-divisions: Part I., Sensibility of the new-born (visual, auditory, dermal, etc., sensibility). Part I. may be described as a condensation of the data reported in Volume I. relating to the sensibility of the new-born, together with numerous quotations from other students of infancy—Tiedemann, Kussmaul, Sigismund, Champneys, Preyer, Mrs. Moore, Mrs. Hall—and from the anatomical studies of Professor Flechsig in explanation and confirmation of the views expressed in the text. The principal conclusions of Part I. are:

> The child is at birth capable of receiving impressions in every department of sense (unless for a short delay in the case of hearing). . . . The sensations of the new-born are very limited and feeble, and seem to be simple and detached experiences, . . . are justly to be regarded as *pure sensations* in which there is no consciousness of space, of externality or internality, of surrounding objects, or of self (pp. 12, 47).

Part II., The Synthesis of Sense-Experience (the visual-motor association series, the tactile-motor association series, synthesis of the visual-motor and tactile-motor associations, auditory associations, associations of the minor special senses, feeling of a bodily self). This part (the nature of which is sufficiently well indicated by the heading and sub-headings) contains, in the writer's judgment, the best treatment of the topic heading the chapter which has thus far appeared.

The author's principle of classification is used with great effectiveness in this part in organizing and interpreting the wealth of detailed observations which she had previously reported.

It is amusing to note in passing that the author completely pulverizes, in the crucible of over-literalness one may think, Professor James's oft-quoted, "big, blooming, buzzing confusion" as a description of the mental state of early infancy. Her way is better: it is more scientific, and it is more euphonious, more poetic. She writes:

> Rather does the babe drift softly in among phenomena, wrapped away from their impact in a dim cloud of unconsciousness, through which but the simplest and faintest gleams and echoes make their way to him. . . . (Vol. II., pp. 144 f.).

Part III. traces the Development in Discrimination and Interpretation in the different sense-departments—sight, hearing, touch, etc. The treatment of sight, particularly the section on "color vision," is worthy of special mention.

Two general conclusions of the entire work remain to be noted: (1) The development of the senses does not follow the phylogenetic parallel—though some specific phases of the

development show such correspondence, (2) the psychic life of the child centers from the first about the higher senses, especially sight, not the lower.

The Pedagogical Conclusions, Part IV., are all interesting, most of them are well-grounded, some of them are novelties or at variance with current practise and doctrine. But Dr. Shinn does not prescribe with undue confidence; pedagogy is still too much a matter of individual opinion, of more or less, of the true or false, practical or impractical, according to circumstances, to warrant laying down iron-clad rules for the management of infants. She does, however, offer a few general principles and a few special suggestions: (1) Nature herself will, in the main, attend to sense education. (2) Nothing in the infant's environment educates it as does the human presence. . . . The baby who is left lying on the bed alone a great deal, does not develop as brightly, and learn to use his senses happily as soon, as the baby that is cooed over and played with. (3) The secret of happy and wholesome development in the early years seems to be mainly in giving the largest possibility of free action. (4) When the child reaches the stage of instruction "tasks must be set, and efforts must be made." (5) The superficial recapitulation theory that a child is "only a little animal," and in no need of human education, often leads to harmful neglect of the early years. (6) The child can and probably should be taught before the end of the second year the names of all the simple plane figures, the alphabet, the Arabic figures, and to discriminate and name the principal colors.

It may safely be said that the 682 octavo pages of the two volumes before us, together with the volume on "The Biography of a Baby," published in 1900, and a number of magazine articles, entitle Dr. Shinn to the distinction of having made the largest, and, in certain respects, the most important contribution to our knowledge of the mental life of babies; and, somewhat incidentally, she has given us data and interpretations of no slight value in the treatment of the problems of functional and analytic psychology. It is clear that Dr. Shinn has not exhausted her store of data. Students of infancy and childhood will welcome forthcoming volumes, if such there be, in the assurance that they will contain valuable material presented in a readable form.

To be sure, no one will take up volumes which trace the physical and mental development of infants and expect light, summer afternoon reading. As literature, books on child psychology rank a little higher, but not much, than laboratory guides in chemistry; and for the present they are not likely to be interesting except to persons who have babies near at hand whom they wish to study and to the specialists in psychology.

Finally, the writer may be permitted a few general observations in the way of suggestions for future editions: (1) The work should take account of the recent studies in this field, (2) the number of repetitious passages might be considerably reduced, (3) many of the footnotes should be incorporated in the text, (4) a full table of contents for each volume would add to the value of the work.

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Nautical Charts. By G. R. Putnam, Mem. Am. Soc. C. E. Pp. viii + 162 (including 35 pages of illustrations). New York, John Wiley and Sons. 1908.

The author of this book has had long experience in the coast and geodetic survey. During the years 1900–1906 he was the director of coast surveys, Philippine Islands, in general charge of extensive surveys made for the production of nautical charts. He is now in charge of the drawing and engraving division at the Coast and Geodetic Survey Office, Washington.

The book is written in non-technical language to as great an extent as is feasible. The general reader will find it clear and concise.

A carefully selected two-page list of the more important books or papers bearing on nautical charts and related subjects is given.

A chapter (30 pages) entitled, Charts and Maps, gives a short historical statement of the

development of the chart from the earliest known map to the present time, indicates the purpose and character of the one million nautical charts now published each year, and shows the present state of advancement of surveys for charting purposes. A double page reproduction of the earliest extant chart showing America is to be found in this chapter.

The collection of information for charts is treated in 34 pages. An excellent statement, fully illustrated by photographs and drawings, is made of the methods of surveying employed. The essential difficulty of making certain, even in a closely surveyed region, that no isolated pinnacle rock reaches up so near to the surface as to be a danger to navigation, is clearly indicated by text and illustration. An example is given of the recent discovery, in Blue Hill Bay, Maine, by the use of a wire drag, a special device for that purpose, of a pinnacle rock only six feet in diameter at its top. The rock has but seven feet of water upon it, although it is surrounded by depths of 78 feet, from which it rises nearly perpendicularly. The caution necessary in sifting evidence in regard to reported dangers to navigation and in making examinations for such reported dangers is illustrated by numerous concrete examples. It is important that chart users should have some knowledge of these matters in order that they may know what reliance they should place upon charts, upon the one hand, and what reliance to place upon hasty criticisms of charts, upon the other hand.

In the chapter of 19 pages, entitled, Preparation of Information for Charts, descriptions are given of the mercator projection, the polyconic projection and the gnomonic projection, and the special advantages of each are stated. The necessary limitations of each are also indicated. These are the three projections which one must understand to use charts intelligently.

Thirteen pages on the Publication of Charts are devoted mainly to a short enumeration of the various processes involved in passing from the drawings to the printed charts, such as engraving on copper, copperplate printing, printing from stone, photolithography, etching, etc., and of the advantages and disadvantages of each process or combination of processes now in use.

The imperative need for frequent correction of charts is treated in 15 pages. The average loaded draft of the twenty largest steamships was 24 feet in 1872 and 32 feet in 1903. Channels and harbors are dredged and otherwise improved and changed. Great natural changes take place. An island of sand has moved northwesterly for two miles directly across the mouth of the Columbia River in Oregon during the years 1851–1905 and has closed up the former channel. An average of 400 new rocks and shoals, dangerous to navigation and not previously shown on charts, are reported each year, according to British reports. Of the 367 reported in 1906 only 11 were discovered by vessels striking them.

In the last three chapters of the book (48 pages) there is brought together in convenient form for reference much information of value to the navigator who has the charts before him and desires to understand and use them. He will there find the charts explained; will find clear general directions given for plotting upon the charts, for locating a vessel from the results of astronomic observations, as well as by dead reckoning, by compass bearings, by sextant angles, and by sounding; and will find certain precautions which are advisable in the use of charts stated with the reasons for them. The book closes with six pages in regard to the various publications in book and chart form which are necessary or convenient for use in connection with nautical charts.

For any one having to do with charts, this book contains much useful information, set forth in the form of a handbook rather than of a technical treatise. For mariners, yachtsmen, surveyors and shippers it is of special interest. The expert in the lines treated will find it valuable in furnishing a good general view of the subject by an expert. The book is up to date, is written in an interesting manner, and yet is especially to be commended for laying emphasis upon matters which are really important to the users of charts, rather than the matters which are merely interesting.

J. F. H.

West Virginia Geological Survey. Vol. IIA. Supplementary coal report. I. C. WHITE. Pp. xiv + 720 and map. 1908.

It is now five years since the publication of Dr. White's first volume on the coals of West Virginia. That was prepared from notes made by its author during many years of examination prior to organization of the state geological survey; so that, while giving matter of the utmost importance, it was more or less fragmentary and gaps remained in critical areas, where was to be sought the solution of some difficult problems in correlation.

More than two thirds of this supplementary volume is devoted to the Pottsville series, which occupies the southern part of the state on and beyond the New and Kanawha Rivers. Five years ago, positive correlation of beds had been determined in only a small part of this area and identifications elsewhere were little better than tentative. But during the interval many bore holes have been drilled and the cores have been measured with care; these measurements, and those of numerous exposed sections have made possible reconstruction of the general section and correction of errors found in earlier publications. It is unnecessary to mention these errors here, for though some of them were serious from the stratigrapher's point of view they are no longer, except in a very few instances, important from the economic standpoint, as the corrections have come in time. They reflect no discredit on the earlier students, as the deposits are so variable that the exact conditions could be ascertained in the semi-wilderness region only by the aid of diamond drill borings.

The Pocono anthracite, just west from the Great Valley, receives proper attention. Now that official condemnation of the coals is available, it may be hoped that the Dora coal fields will no longer prove a source of profit to coal experts and of loss to would-be investors. Dr. White calls attention to the fact that, while the Pocono coal beds are found only along the easterly border of the Appalachian coal field, the same great formation is rich in petroleum and natural gas within the central and western parts of the field. He suggests that, in the deeper portions of the area where land plants could not flourish, there was a growth of marine plants and animals whose remains were changed into those hydrocarbons.

Dr. White divides the Pottsville series into Beaver, New River and Pocahontas, a much better grouping than that offered by Stevenson, as it recognizes the early work of Fontaine on New River and that of David White in the Pocahontas and southern Anthracite field; the individuality of the lower divisions is as distinct as is that of the Beaver. The area of the Pocahontas and New River coals is not far from 2,600 square miles and the amount of available coal is estimated at 10,000 millions of tons. The coals are of remarkable excellence, very low in ash and sulphur; those of the Pocahontas have usually less than 18 per cent. of volatile matter, so that they are practically smokeless when properly stoked and are the typical steam coals. The New River coals are richer in volatile, 17 to 26 per cent., but are as low as the others in ash and sulphur. These coals thin away from the southwestern outcrop and disappear toward the northerly and northwestwardly border of the basin in which the lower and middle Pottsville were deposited, each important member of the column overlapping its predecessor toward the west.

The new borings and sections have made clear the relations of the Kanawha or Beaver coal beds. The imperfect sections of five years ago in counties immediately north from the Kanawha have been replaced with numerous excellent measurements, which show that Stevenson's identification of the great Roaring-creek coal bed with the Stockton bed of the Kanawha is an error, the former being about 50 to 75 feet above the latter. The Kanawha black flint, overlying the Stockton, has been discovered below the Roaring Creek sandstone (equivalent to the Homestead of Pennsylvania) so that it can not be the Putnam Hill limestone of Ohio and is most probably at a Mercer horizon, 70 or 80 feet lower.

The Roaring Creek coal bed is taken by Dr. White to be the Lower Kittanning, the next bed above the Brookville, to which Stevenson

referred it. This difference in opinion is unimportant, as this is the lowest bed of the Allegheny in the region and is at only 10 to 30 feet above the sandstone which forms the top of the Pottsville.

This supplementary report is merely synoptical and it will be supplemented in turn by county reports giving the structure in detail. The plan and execution of the survey work are admirable; the measurements are very numerous and the correlations have been made with patient study; the analyses are in great part both proximate and ultimate and the number of them is unusually large. The new material, bearing on the origin of coal and the accumulation of coal beds is perplexingly important; if much more of this sort be presented, reconstruction of many familiar hypotheses will be necessary and much fine writing, of which the authors were justly proud, will become merely historical lumber.

JOHN J. STEVENSON

SCIENTIFIC JOURNALS AND ARTICLES

The Museums Journal of Great Britain for October, under the title "Board of Education: Circulation Department," states that the Victoria and Albert Museum contemplates extending the operations of its circulation department which is concerned with the loan of collections to provincial museums. In "Notes on an Eighteenth Century Museum" Thomas Southwell gives much information about the *Museum Boulterianum* a typical institution of its period. This contained many objects brought home by Capt. Cook, including specimens of *Hemignathus obscurus* and *Vestiaria coccinea*. The article on "The Lund Museum for the History of Culture" contains a brief discussion of the extent and character of restorations of art objects.

The American Museum Journal for November contains a brief account of "Cuthbert Rookery," the last of any size left in the state, and information as to "The Stefansson-Anderson Arctic Expedition" which is at work on the northeast coast, while Harlan I. Smith presents some of the results of "The Archeological Reconnaissance of Wyoming." It is noted that the Tuberculosis Exhibit will be opened the latter part of November. The number contains the lecture programs of various courses.

The Bulletin of the Charleston Museum for October notes the installation of the Museum Library in the new building and calls attention to the fact that it is the first free public reading-room in the city. The offices and workrooms are also in the new building and the re-arrangement of the collections is proceeding as fast as is possible.

The Zoological Society Bulletin for October contains an illustrated account of the elephant house soon to be opened to the public, and probably the most complete structure of its kind extant. In a note on "A Large Sea Turtle" (*Dermochelys*) it is stated that "It is not likely that any species of sea turtle exceeds 1,000 pounds in weight." This is probably true; it is surprising how animals shrink before tape line or scales and so far as we know the 840 pounds of this turtle is the maximum actually recorded. Mr. Beebe presents Part I. of an illustrated article on the "New World Vultures." He remarks that they apparently lack the sense of smell, but *per contra* it is to be noted that the olfactory lobes of *Cathartes* are well developed, being much larger than those of other birds. And what are olfactory lobes for but to record smells? Attention is called to the necessity for raising a fund for the purchase of bison for the Montana herd for which the government has provided a range.

THE tenth volume of the *Transactions* of the Texas Academy of Science, including the proceedings for 1907, has just been published. Its contents includes the following papers: "The Resistive Powers of the Animal Organism," the annual address by the president, Dr. James E. Thompson, professor of surgery in the medical department of the University of Texas, Galveston; "A Theory of Ferments and their Action," by Dr. James W. McLaughlin, Austin; "Soil Fertility and Phosphoric Acid," Dr. George S. Frapps, state chemist, College Station; "Lord Monboddo—

A Precursor of the Darwins," by May M. Jarvis, M.A., University of Texas, Austin; "Fossil Tracks in the Del Rio Shale," by Professor J. A. Udden, Augustana College, Rock Island, Ill.; "Some Figures on the Cost of Train Service," by R. A. Thompson, C.E., chief engineer of the Texas Railroad Commission; "The Law of the Fall of Rivers and the Value of the Deduced Curve in River Improvements," by F. Oppikofer, C.E., Tarpon, Texas.

BOTANICAL NOTES

ANOTHER ELEMENTARY BIOLOGY

THE recently published (Macmillan) "First Course in Biology" prepared by Bailey and Coleman is disappointing in that the presentation of the two sides of the subject is very unequal, that relating to plants being much inferior in every way to that relating to animals. Pedagogically, practically, and still more, scientifically the treatment of "Plant Biology" falls far below what we had a right to expect from the author. In the two hundred pages given to this subject there are brought out a great many interesting and useful facts, charmingly told, but they are presented in an unorganized form. There appears to be no orderly sequence in the presentation of the matter contained in the chapters. Thus the pupil is told in the first chapter that "no two plants are alike," which may or may not be important for him at this stage of his education; then next he is asked to consider plant adaptation, followed by two pages devoted to "the survival of the fit." The fourth chapter deals with "plant societies," the fifth with "the plant body," the sixth with "seeds and germination," the seventh and eighth with the root, etc. The twenty-third chapter includes six pages, devoted to "phenogams and cryptogams," a careful study of which must leave the pupil in a good deal of confusion as to the differences between spore-bearing and other plants, and the nature and significance of alternation of generations. The closing chapter consists of "more extended excursions into the cryptogamous orders." The author's unfamiliarity with this portion of the plant kingdom is evident. Witness this description of lichens (p. 195)—"they are thin, gray, ragged objects, apparently lifeless," and "they are now known to be green cells of various species of algæ overgrown and held together (imprisoned) by the mycelium of various kinds of fungi." What idea could a high-school pupil get from such statements? In the preface to the book the author refers approvingly to the "revolt against the laboratory method" and decries the study of botany "without really knowing plants"—but certainly this book in its present form is not likely to remedy these educational abuses. It must be remembered that even though one may intend to be very "practical," and have the gift of entertaining and attractive writing, it is still necessary to be strictly accurate in the statement of facts, and to carefully arrange the sequence in which these statements are presented. It is clear that the botanical part of this book should be revised, rewritten and rearranged before a second edition is issued.

CANADIAN ROCKY MOUNTAIN BOTANY

SOME time last year Mr. Stewardson Brown, the curator of the herbarium of the Academy of Natural Sciences of Philadelphia, brought out a pretty book on the "Alpine Flora of the Canadian Rocky Mountains" (Putnams). The author says it "is meant only as a guide to the rich and interesting flora of the Canadian Rockies and Selkirks, or those portions traversed by the Canadian Pacific Railway between Banff and Glacier." It is thus a tourist's book, but its treatment is such that it becomes a useful book for the botanist, also.

It opens with a glossary of such terms as might puzzle the non-botanical amateur, and following this is a good key to the families. In the text the characterization of the families is brief and non-technical, as are also the descriptions of species. The genera are not characterized further than is done in the keys to the genera given at the beginning of each family. It should be stated that the nomenclature is of the modern kind. At frequent intervals are plates, either half-tones of photographs, or colored reproductions of water-

color drawings. A good index closes this volume, which must prove very useful to tourist or botanist in the Canadian Rocky Mountains.

ORCUTT'S AMERICAN PLANTS

FEW eastern botanists can realize the difficulties of the student of systematic botany in the far west, where there are no handy manuals containing the descriptions of all the flowering plants and ferns and in some cases plants of lower groups also. For some years Mr. C. R. Orcutt, of San Diego, California, has attempted to remedy this condition by bringing together the descriptions of genera and species of south Californian plants. We have often wished that his type and paper were better, but work of this kind is a labor of love, and in the absence of an endowment must be brought out at the least possible expense. It is greatly to Mr. Orcutt's credit that he has been able to bring out this book of nearly two hundred pages of descriptions, many of which occur in widely scattered publications. From the title-page we learn that the volume contains "descriptions of over 200 genera, more than 1,200 species and many varieties." A second volume is in preparation, at the close of which we are promised an index to the two volumes. This will make the work much more useful, for with no index it is well-nigh impossible to find any particular description without the expenditure of much time. When these descriptions are all brought out, they should be put together in the form of a systematic manual of the plants of southern California.

A HIGH-SCHOOL BOTANY

NOTICE should be made here of Coulter's text-book of botany for secondary schools recently brought out by the Appletons in the excellent type, paper and presswork which is characteristic of their publications. The plan of the book is that which has been generally followed in recent years. There is first a general part (less than one hundred pages) in which gross and microscopical anatomy are taken up by the pupil, and this is followed by chapters on algae, fungi, liverworts, mosses, ferns, horsetails and club-mosses, gymnosperms and angiosperms, nearly one hundred and fifty pages being given to an admirable treatment of the morphology and general classification of the plants of these groups. Then follow two chapters (20 pages) on flowers and insects, and seed dispersal, and then 61 pages on the structure and classification of monocotyledons and dicotyledons. The remainder of the book (about 40 pages) is given to little snatches of discussions of plant breeding, forestry, plant associations, hydrophytes, xerophytes and mesophytes. Some of these closing chapters could well be omitted, since the necessarily brief treatment is wholly inadequate. However, taken as a whole the book is one of the best of those adapted to use in the high schools.

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SPECIAL ARTICLES

MENDELIAN HEREDITY

ONE might suppose, at first thought, that, in cases of Mendelian heredity, the dominant form would be capable of gaining over the recessive in the course of evolution, merely from the nature of the dominance. The falsity of this view was well shown by Shull (1907) and more recently by Hardy (1908). The successful increase of a mutation depends upon aid from determinate evolution or natural selection. Here we are only concerned with the work of the latter.

Shull maintains that the view that recessiveness is a handicap is quite erroneous; "not only has the dominant form no advantage in the competition which the newly arisen elementary species must encounter, but it can be shown that under certain conditions the reverse is true." He then clearly shows that, where the new characteristic has less favorable chances of survival at the time, recessiveness is an advantage, for it may be shielded from extermination by being carried without somatic expression.

But if we assume the opposite condition, namely, that the new characteristic is more favored than the parent species, then dominance gives an advantage because the characteristic will be present in each generation,

thus permitting the work of natural selection in increasing the numbers to work without interruption.

The recessive character, on the other hand, only occasionally manifests itself, so that natural selection seldom has an opportunity to aid it. This advantage that dominance wins for the characteristic is especially important, because the early generations are the critical period for every new characteristic. Even a favored characteristic may succumb during the early days, when all the eggs are in one basket, so to speak, so numerous are the chance deaths.

Trimorphic heredity, where the heterozygotes constitute a third form different from the parents, also affects the action of natural selection. In this case the *utility of the new characteristic is less important than the utility of the heterozygous characteristic* in the determination of the fate of the characteristic in question. In some cases, the heterozygous characteristic is so different, as in the Andalusian fowl, that it is quite conceivable that the selective value of the heterozygous characteristic might be even opposed to that of the original characteristic. More frequently it would have a decreased value, whether it be negative or positive, which may reduce it to no selective value. A characteristic might have a high utility, but if its heterozygotous condition lacked it, it would probably fail unless some other factor, such as assortative mating or determinate evolution, should come to its rescue. There is a possibility that the heterozygote might be favored by a selective value with the extracted characteristic neutral. It might then be successfully established by natural selection in spite of its own lack of selective value. Again the heterozygous characteristic may be favored and the extracted characteristic opposed. In that case the success of the heterozygote would be jeopardized. Rescue might come for it in the shape of a fixed heterozygous condition, such as that of the Barred Rock poultry.

The method of inheritance plays, then, a large rôle in the action of natural selection.

Roswell H. Johnson

October 11, 1908

The Otter in Massachusetts

It is not commonly known that the North American otter (*Lutra canadensis*) is nowadays anywhere in Massachusetts a frequent victim of the trap or the gun of the hunter. It appears, however, that the otter has escaped extermination in spite of its valuable fur, and in certain sections of the state has apparently gained in numbers. The solitary habits of the animal and its shyness may have conduced to its preservation. It has, nevertheless, always been eagerly sought wherever its presence has become known, on account of the beautiful pelt, which to-day has a substantial market value.

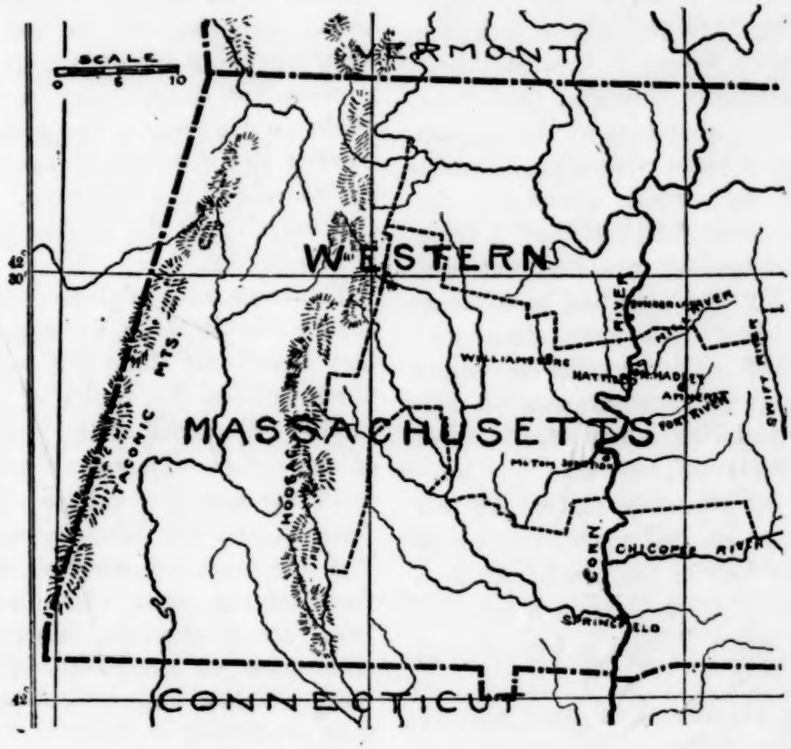
The persecution of these valuable fur-bearing mammals, it would seem, would have led to their extinction. While their shyness and general recluse habits are in their favor, their size and certain other instinctive habits are against them. The otter seems to be a playful creature and apparently enjoys a frolic with a companion or alone. During the rutting season, perhaps at other times as well, it is known to enter into the pastime of sliding on the snow or a muddy river bank into the water of a stream or pond, and to repeat this performance many times. These otter slides are the trappers' "signs." Apparently, too, the creature may have a sort of "playground" or place where it more or less regularly leaves the water for a roll in the snow or mud.

The great traveling capability of the otter is attested by its wide distribution. It is said to be generally distributed over North America, apparently in no great abundance at any one place, but likely to be met with in localities adapted to its habits. The roaming habit, of course, in a way stands between it and destruction. In its new haunts it may live and breed for some time, undiscovered. In the old it would probably have been hunted so relentlessly that it would have been extirpated.

It is to me a matter to occasion some surprise that the otter is as abundant as records seem to show, in certain parts of this state. The otter has always been included in a list of the mammalian fauna of the state. It appears at no time to have become so deci-

mated in numbers as to have been excluded from such a list. In 1835[1] E. Hitchcock included it in his list of Massachusetts mammals, without any reservations, from which fact we may infer that if not abundant it was yet fairly common. In 1840[2] E. Emmons wrote: "The otter is still an inhabitant of our waters, but, from its shyness, watchfulness and aquatic habits, is rarely seen and still more rarely captured." In 1861,[3] however, E. A. Samuels referred to the otter as "once quite common," but "now nearly exterminated, one in two or three years being about the greatest number captured." He reported a specimen killed that season near Marlborough, Middlesex County, and another at Palmer, Hampden County. Eight years later[4] J. A. Allen wrote of the otter as "not rare; still not often captured," and stated that during the ten preceding years some half dozen had been taken near Springfield.

Records are not at hand for later years up to the winter of 1905–6. During that season a party fishing through the ice at an ox-bow of the Connecticut River one half mile north of Hatfield caught an otter. In the confusion following this unexpected catch the creature escaped. In the succeeding autumn another fine specimen, a male, was taken in the town of North Hadley, just across the river from Hatfield, from a mill pond in a creek known locally as "Mill River." A few months later still another specimen, an old male, was taken from this pond. The skeleton and mounted skin of this animal are now in the Massachusetts mammal collection at the Agricultural College. Shortly afterwards a third male was caught from this pond. The trap had been set at the "playground" of the animals. Tracks have frequently been seen near "Fort River," a few miles south of "Mill River," and in a mill pond of this stream, another was trapped in the winter of



[1] Report on Geology, Mineralogy, Botany and Zoology of Massachusetts, 1835, p. 526.

[2] Report on Quadrupeds of Massachusetts, 1840, p. 48.

[3] Agriculture of Massachusetts, 1861, Part I., p. 160.

[4] "Catalogue of the Mammals of Massachusetts, with a Critical Revision of the Species," *Bull. Mus. Comp. Zool.*, Cambridge, 1869, p. 178.

1907–8. In the early spring of 1908 a pair of otters were shot in the "old bed," a large ox-bow of the Connecticut near Mt. Tom Junction. In the preceding winter months a boy shot another on a cake of ice in the Connecticut River near Hatfield. At Sunderland, north of Amherst, in the same season, another specimen was shot in a brook, tributary to the river. In Swift River, a few miles east of the Connecticut, two others were caught in a trap within the last two or three years. Traditions of the presence of the otter, a dozen, twenty and more years ago are common among the residents of the river towns in this neighborhood, but it is generally conceded that these animals appear more abundant at the present time than for many years preceding.

A few weeks ago while searching for microscopic forms near "Mill River" I came upon a large otter feeding in a stagnant pool near the creek. My approach had been along the road. The dust was very deep and muffled every sound. The creature remained feeding—apparently on vegetable matter, possibly frogs—or paddling about for several minutes at a distance of less than one hundred feet from my standing place. At last it evidently saw or scented me and mounted the bank and was lost in the brush. It soon emerged at the bank of the stream a hundred yards away and swam around a bend out of sight.

The surprising abundance of these animals in the Connecticut Valley is thus shown and seems to be a matter deserving of record. The extent of their presence elsewhere in the state can not be stated with any accuracy. Dr. Glover M. Allen[6] reports that they are occasionally seen about the Charles River in the eastern part of the state, he having found unmistakable tracks of the otter near Dedham, Norfolk County, two winters ago.

It is, of course, possible to postulate the persistence of these animals in this state as a logical consequence of their shy habits and tendencies to roam about. At times they might appear to decrease in numbers when eagerly sought for their fur. When the relentlessness of the hunter abated they would multiply and attract attention once more, the streams or ponds where the creatures had been driven serving as centers of dispersion. The younger animals, not having the experience of the older ones, would be less wary and timid; might, indeed, if unmolested for some time, become comparatively bold. The comparatively large size of these animals and their habits, however, would reveal their presence. Even their roaming habit is in a measure against them, as they are essentially stream-loving animals, and in the winter months when searching for the rapids and falls of the streams for open water would leave their tracks in the snow. The otter is a good land traveler and does not always follow the winding courses of the waterway. Their comparative scarcity in the eastern part of the state is noteworthy.

The abundance of these animals in the Connecticut River valley has suggested to me that they have come along this waterway from the north outside the limits of the state to the smaller tributaries of the river in the lowland of the valley. They may have traveled eastward through the valleys of the Ware, the Assabet, and the Blackstone to the seaboard. But one must not overlook the possibility of their having come along another waterway from the north—the Merrimac, along the tributaries of which—the Concord and the Nashua—they might have easily made their way southward.

The emigration from Vermont of terrestrial mammals is a matter of common knowledge. This emigration is along the Hoosac and Taconic ranges in the western part of the state. Early reports record many wild mammals in these districts, but their numbers are fewer, apparently, at present. In the fall of 1907, however, a black bear (*Ursus americanus*), variety not known, was shot near Williamsburg in the eastern foothills of the Berkshires. Some indication of the number of wild cats is had from the treasurer's records in Berkshire County. By the enactment of our general court (Chap. 344, Acts of 1903) provision is made for the payment of a bounty of $5.00 for every wild cat (either

[6] Personal letter.

Lynx rufus or *L. canadensis*) killed in the state. The following bounties have been paid in Berkshire County under the provisions of this act: 1903, $100; 1904, $110; 1905, $115; 1906, $100; 1907, $60.[6] The records are not sufficiently explicit as to the species of *Lynx*, but the loupcervier seems far less common, as in only a few cases was the distinction made on the certificate. These animals (*L. rufus*) are sporadically reported from other sections of the state, but often from localities that lead to the suspicion that they may have immigrated from the western hilly or mountainous parts.

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SOCIETIES AND ACADEMIES

THE PHILOSOPHICAL SOCIETY OF WASHINGTON

THE 652d meeting was held on October 10, 1908, President Bauer presiding. The following papers were presented:

Vertical Temperature Gradients of the Upper Atmosphere: Mr. W. J. HUMPHREYS.

The extensive work that has been done during the past ten years in exploring the air with sounding balloons was reviewed and illustrated with typical curves.

The records obtained with these balloons show that for about 3,000 meters above the surface of the earth the winds are turbulent and the temperature gradient irregular. Above this for some distance the temperature decreases nearly uniformly to a minimum at an altitude of from nine to fifteen kilometers usually. This height and the temperature both are functions of season, of latitude and of type of weather; and the temperature gradient is similarly affected.

Above the minimum the temperature gradient usually changes abruptly and from that point up as far as soundings have been made slowly increases.

All these phenomena were separately discussed and explained as mainly due to the amount and distribution of water vapor in the atmosphere and the consequent location and temperature of the effective radiating surface of the earth.

The results are in accord with the best determinations of the solar constant and with the known laws of radiation and absorption.

[6] Personal letter, Mr. Henry Brewster, treasurer of Berkshire County.

The New Magnetic Survey Yacht "Carnegie": Mr. W. J. PETERS.

A paper on the proposed new vessel designed for a continuation of the magnetic survey of the oceanic areas.

The paper first gave the reasons which made it desirable to purchase a vessel especially built for the requirements of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington. Then followed data concerning the size, sail area and expected performances.

A brief description of the living quarters, accompanied by slides, and also a statement of the methods of observation which are to be on the lines followed in the previous work on the *Galilee* in the Pacific Ocean.

There was also exhibited a graphic representation of the curves of expected maximum ship deviations. A more complete publication will appear elsewhere.

THE 653d meeting was held October 24, 1908. The following papers were read:

The Results of Recent Observations in Atmospheric Electricity: Mr. P. H. DIKE.

The paper gave a summary of some of the recent work in atmospheric electricity and showed the relationship of this work to that done along the same lines on board the Carnegie Institution Magnetic Survey Yacht *Galilee* during the cruise recently finished.

Continuous records made at various observatories of the course of the potential gradient show its extreme variability and slight apparent connection with other atmospheric phenomena. It is of interest as a factor in the determination of the earth-air current.

The discovery of the ionization of gases led to the study of the conductivity of the air, at first by faulty methods through the lack of appreciation of the errors due to saturation currents. J. J. Thomson cleared up the misunderstandings and led the way to more accurate work. For field work the Gerdien conductivity apparatus has been found most useful, and gives fairly consistent results. In conjunction with the record of the potential gradient it gives the earth-air current in absolute measure. Gerdien has found this current at Göttingen to be about 2.5×10^{-16} amperes, with a conductivity for positive electricity of 1.16×10^{-4} electrostatic units and for negative of 1.12×10^{-4} electrostatic units.

The speaker had made use of the same type of

instrument on board the *Galilee*, making observations at sea from latitude 55° 41′ north to 45° .07′ south, but was unable to measure the potential gradient. The conductivities found gave as means $\lambda p = 1.60 \times 10^{-4}$ and $\lambda n = 1.433 \times 10^{-4}$ electrostatic units, somewhat greater than Gerdien found on land. A description of the method of observation at sea was given and the difficulties mentioned. Calibrations of the electroscope in New Zealand and at the Bureau of Standards in Washington showed its sensitiveness to be nearly constant, but gradually increasing.

C. T. R. Wilson's method of measuring the earth-air current was described. He uses a test plate maintained at zero potential while insulated from the earth, and arrives at a value for the current almost identical with that of Gerdien, namely, 2.2×10^{-16} amperes. Mention was made of Schering's work in Göttingen on the continuous registration of the conductivity of the atmosphere, and his apparatus described. He avoids saturation currents by removing the charged body to a sufficient distance from earthed conductors, and obtained a trace showing the course of the conductivity by means of an electrometer connected with the charged body.

Satterly at the Cavendish Laboratory, Cambridge, Eve at Montreal and Ashman at the University of Chicago, have all made independent determinations of the quantity of radio-active emanation in the atmosphere in terms of the mass of radium per cubic meter required to maintain in equilibrium the observed amount of emanation. Ashman condensed the emanation by cooling with liquid air, Eve absorbed it with cocoanut charcoal and Satterly used both methods. The results give as the radium equivalent per cubic meter according to Ashman 97×10^{-12} gram, Eve 60×10^{-12} gram, from results extending over a year, and with a ratio of maximum to minimum of 7 to 1, and Satterly, 88×10^{-12} gram for the charcoal method and over 100×10^{-12} for the liquid-air method.

On board the *Galilee* practically no radio-active deposit could be collected, yet the ionization was as great as on land, tending to disprove the theory that the ionization of the air is due to the radio-active content.

Attention was called to the need for a well-equipped observatory for research along these lines in this country, where the subject has been almost entirely neglected.

Thermometric Lag in Calorimetry: Mr. W. P. White.

Of late, in calorimetry by the method of mixtures, several attempts have been made to avoid an error due to the lag of the thermometer to which considerable importance has been attached.

This error, however, does not exist at all, which may be shown as follows: In a calorimetric run by the method of mixtures, all the temperature data lie upon a temperature-time curve whose form determines both the cooling correction and the main temperature interval. The exact instant at which temperatures on this curve are read is unimportant, so long as the temperature *intervals* are preserved. If now, all temperatures are plotted the same number of seconds wrong, as they would be when the same lagging thermometer is used throughout, no appreciable error can result. The importance of lag in calorimetric thermometers has, therefore, been greatly overestimated.

R. L. Faris,
Secretary

The Elisha Mitchell Scientific Society of the University of North Carolina

The 179th meeting of the society was held in Chemistry Hall on Tuesday, October 13, 1908, 7:30 P.M. The program was as follows:

"Results of the Microscopic Study of the Slate near Chapel Hill," Mr. H. N. Eaton.

"Chemical Energy," Professor J. E. Mills.

"A Further Contribution on the Regenerative Power of Sponges," Professor H. V. Wilson.

Alvin S. Wheeler,
Recording Secretary

Section of Biology, Pittsburgh Academy of Science and Art

The first meeting of the year was held at the Carnegie Institute on Tuesday evening, November 10. At the invitation of the section about twenty-five geologists attended the meeting, and it was decided that there was sufficient interest manifested to warrant the formation of a Geological Section in Pittsburgh. As the Biological Section had already prepared a program which embraced a large number of topics of interest to geologists, it was thought best to combine the two sections for the present year at least. The meeting was addressed by Director W. J. Holland, Dean M. E. Wadsworth, Mr. R. R. Hice, Mr. F. Hewett, Mr. F. Z. Schellenberg, Mr. E. Andrews, Mr. F. S. Webster, Professor J. G. Ogden, Dr. A. E. Ortmann and the secretary of the section.

Percy E. Raymond,
Secretary